# Railway Mechanical Engineer

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## NEXT MONTH

Concluding installment of the operation of the new Juniata locomotive repair shop of the Pennsylvania—Utilization of micrometers, dimension forms and semi-finished material

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# Railway Mechanical Engineer

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**Checking up the foremen**

The *Railway Mechanical Engineer* has had much to say on the matter of foremanship. For many months it has regularly published contributions received in the competition which was held last year on the foreman and his responsibilities and opportunities. It is doubtful if any contest which we have ever held has stirred up so much interest or had such a deep and widespread influence. In addition to the article in this number by Frank J. Borer, well known to readers of the *Railway Mechanical Engineer* because of his many contributions to our columns, will be found a letter referring to the "Bill Brown—Top Sergeant" controversy and sizing up the foreman from the viewpoint of a mechanic. We wish that we might have more communications of this sort, because, after all, the important thing is the impression that the foreman makes on the men who work under his direction. Undoubtedly railroad shop management practices would be revolutionized if every foreman clearly understood just what the men under him thought of him and how they viewed his actions. Few mechanics have the ability or hardihood to approach their superiors and talk with them frankly about such matters. We are delighted, however, to have one craftsman express himself in our columns, even though he has had to do it in an impersonal sort of way.

**The apprentice training problem**

We had quite a bit to say in the March number of the *Railway Mechanical Engineer* on the question of apprentice training. Readers of technical publications, unlike radio fans, do not greatly concern themselves with letting the editor know what they think of the publication and its policies. The few reactions that we have received to the editorial comment and articles in the March number have indicated approval of our position, but on the other hand, they are so few that they do not represent in any adequate way the opinion of our readers at large, nor do they reflect the attitude of more than a very few railroads. Following the article by C. Y. Thomas, supervisor of apprentices of the Kansas City Southern, in which he made a constructive suggestion looking toward the greater expansion of modern apprenticeship methods, we are presenting in this number another strong, constructive paper by F. E. Lyford, apprentice instructor of the Lehigh Valley at Sayre, on "The Moral Side of Apprentice Training." Mr. Lyford takes a keen personal interest in the apprentices at the system shops at Sayre. He feels strongly that there is something far greater in apprentice training than the mere education of the apprentice in manual skill and the theory and technique of the craft. The railroad needs employees of strong character and personality and the community needs better citizens. Is it not just as much a function of the apprentice department to help to develop character and citizenship as it is to turn out a skilled craftsman? What do you think of Mr. Lyford's suggestion?

**Work reports should be carefully checked**

Enginehouse efficiency is measured not only by the quality and cost of the work performed, but also and perhaps principally, by the speed with which the work is done. The back shop may take whatever time it needs to do its work in a systematic manner, but the enginehouse is required first of all to have locomotives ready when they are needed for the handling of trains. The necessity for speed quite often makes it impossible for the enginehouse forces to make a thorough examination of the locomotive as the work is being done to see if any repairs are required that have not been reported, and they have to depend largely on the information contained in the work report for the planning and performance of the work. Thus the work performed by the enginehouse forces is created by the engineman's work report, supplemented by the report of the outside inspector, which is made out as the locomotive goes over the inspection pit; from the standpoint of enginehouse efficiency, it is essential that these work reports show all the work that ought to be done on the locomotive before it is again placed in service.

It is customary on quite a number of railroads for the engineman and inspector to go over the locomotive together. While not always practicable, such a procedure does provide a check and quite frequently reveals defects that might otherwise be overlooked. The combined knowledge of the engineman and inspector, working together, should produce a sufficiently complete report by which the enginehouse forces can do a thorough repair job and it should only remain for the enginehouse foreman to see that the forces under his direction perform the work called for in the work report.

The importance of making intelligent work reports cannot be overstressed. It might be said that they control enginehouse production. Defects not reported are usually not corrected and quite often a minor defect which is overlooked will eventually cause an engine failure and require costly repairs.

It is customary on practically all railroads when a delay or engine failure occurs to make a check of the work reports. This, alone, however, is not sufficient to insure the right kind of work reports. Traveling engineers should check the enginemen's work reports to see that the information given to the enginehouse is complete. This work should be supplemented by frequent inspections by both the traveling engineer and master mechanic. They should call the engineman's attention to defects he did not report and drive home the fact that the work will not be

done unless it is reported. The enginehouse foreman should see that the work reported is properly performed and if the work is not done, the mechanic making the examination should be required to give the reason why he did not do the work. Insist on the enginemen making intelligent reports as they are in a better position to discover many defects while the locomotive is working than the enginehouse inspector. It is only by furnishing the enginehouse complete work reports that it can be expected to function properly in keeping down engine failures and running repair expenses.

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**Let's bring out the facts**

The success with which locomotive shop scheduling has met in a great number of instances offers fairly convincing evidence that any railroad repair shop can hardly afford to be without some kind of a scheduling system. Fundamentally shop scheduling, or the routing of work, is nothing more nor less than some plan which will set a definite time in proper sequence for each operation to be performed so that there will be no lost motion in the job as a whole.

It seems to be characteristic for a railroad shop man either to assume a defensive attitude when the advisability of installing a "system" in his shop is suggested, or else to go to the opposite extreme and allow enthusiasm for a new idea to foster the installation of a system that requires more attention on the part of the supervisors to run the system than is required to run the shop. It is difficult to say which condition is worse—no system at all, or too much system; the company suffers in one instance, and the supervisors in the other.

During the past four years the *Railway Mechanical Engineer* has described several scheduling systems and many more have come to our attention which differ possibly in method of application, but are, in principle, based on similar ideas. One striking fact, however, has been that some relatively small shops have installed quite elaborate systems, while on the other hand, some large shops, turning out two and three times as many locomotives each month, are operating with remarkable results, with the work controlled by a system so simple that its installation added not a single man to the payroll nor a single burden to the supervisory force. Where, then, is the happy medium on scheduling systems?

Present day railroad operation demands the most intensive possible utilization of the facilities at hand. Traffic requirements, sometimes at least, also demand that motive power be held out of service for repairs as short a time as possible. Shop scheduling is merely one way of getting more out of existing shop facilities by taking the lost motion out of men and methods. More than this, an orderly method of performing any job makes that job easier and more interesting. The subject of shop scheduling is a wide one which has been the basis of thought if not of action on the part of almost every progressive locomotive shop superintendent or general foreman.

Locomotive shop operation differs so greatly from industrial plant operation that it is next to impossible for any one not directly connected with the work to contribute effectually to the installation of improved methods. Therefore it seems that the most valuable information which may be expected on this highly important subject must come from those who are faced each day with the solution of shop problems. Now seems to be the proper time for railroad shop men to give serious thought to this subject with the idea of bringing out a discussion of the subject at the meetings of the various associations which mechanical department men will attend during 1926.

**The car man's opportunity**

Training courses for car foremen, inspectors and workmen are not available in the curricula of any colleges or universities, and yet successful car department supervision is an art which can never be brought to the desired high standard unless the average car man backs up his long practical experience and observation by intensive outside study and the utilization of every available means of self improvement. He must not only seek a more intimate knowledge of the details of car inspection and maintenance work, but at least equally essential is a knowledge of how to direct the efforts and secure the loyal support of the men who work for him. Moreover, a broad point of view must be developed so that he may see beyond the confines of his own particular department and visualize how it should be operated in the best interests of the railroad as a whole.

Next to agriculture, railroading is the largest industry in this country, and the car department employs more men and spends more money for labor and material than any other single department of the railroad. Why is it that more car men do not succeed in reaching the higher executive positions? If there is one reason more than another, it is because they become too engrossed in the details of their own special work to see how best to co-ordinate their efforts with those of other departments—how best to develop the breadth of view which is absolutely essential in the successful railroad executive officer.

Car department supervisors have a splendid opportunity to improve their knowledge as car men or foremen (1) by active membership in car foremen's clubs; (2) by reading books on subjects related to their particular work and general railroad subjects; and (3) by studying railroad technical magazines such as the *Railway Mechanical Engineer* which make available to them each month the combined knowledge, training and experience of the best men "in the game." Intensive reading and study are essential, but no mere "bookworm" ever became a railroad president. Something more is essential, and for that reason the necessity of active participation in car foremen's clubs and other associations of railroad men should be particularly emphasized. After all, the ability to meet men, make a favorable impression, and stand up in public and express an idea clearly and concisely, is an invaluable asset to a man in almost any walk of life and railroad car foremen are no exception.

Car foremen's clubs are available in many of the important railroad centers in this country, and where not already organized can be readily developed by a nucleus of live and energetic car men, the privilege of membership being extended to all car men ambitious for personal improvement and the betterment of railroad service. Take the Car Foremen's Association of Chicago, for example. Drawn from the greatest railroad center in the world, the car men of the Chicago district meet once a month for nine months in each year; listen to papers prepared by experts on various phases of car work, and then hear and express opinions on all sides of the various questions brought up. At these meetings many of the men who have made possible the rapid improvement in car design, building, inspection and repair, get together and offer to the younger men in the industry information that no college or university can supply. For members of the association unable to attend meetings, the published Proceedings afford a permanent record of the subjects discussed, providing a valuable library on car inspection, interchange, and repair work.

The Chicago Car Foremen's Association is the largest of its kind in this country and it would be practically impossible to organize the average association on as ambi-

tious a basis, but the fact remains that the car men of the country have a real opportunity in the organization of local clubs, and possibly greater benefit may come from membership in the relatively smaller clubs. The resultant increased knowledge of car department matters and better understanding of how to deal with other men will greatly increase the value of the members to themselves and to the railroads they serve.

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**Better methods in car shop production**

Considerable progress has been made during the past ten years towards obtaining more efficient methods in car shop production. But, in some respects car department is still behind the locomotive department. For example, one will usually find a more complete system of supervision of tools and facilities in the locomotive shop than in the car shop. Tool supervisors and shop drafting rooms are more often included in the locomotive shop organization than in the car shop organization. Yet it is generally recognized that the character of the tools, jigs and fixtures plays a large part in determining the output of the shop, and the utilization and the types selected are of primary importance. Why should not this fundamental factor in car shop production receive the same attention as it does in locomotive repair work?

It is not an uncommon occurrence to see two or three different types of scaffolding or a variety of trucks for handling car doors and steel ends in the same car shop building. A visit to several car repair shops on the same system will often show a wide variety of air operated devices for performing the same functions. Why have all this conglomeration of devices? Surely some must be better than the others. Better efficiency in car shop production could be obtained if more attention were paid by the mechanical department to the standardization of these jigs, fixtures and devices.

The car department might well assign some man who is an expert in car repair work, the task of seeing that all car repair points on the system are using the best possible jigs and fixtures. In many respects his work would be along the same line as that of the tool supervisor in the locomotive shops. He can eliminate tools using an undue amount of compressed air, and substitute other more economical means of doing the same work. His familiarity with all kinds of car repairs and the fact that his entire attention is devoted to the study of car shop tools and equipment, which is not the case with the car foreman, should make his services just as valuable as those of the tool supervisor in the locomotive shop.

If such a study can produce better production in locomotive repair work, it is certainly worth considering in the car department. In fact, a few railroads have had in operation some such system as the one proposed, for a number of years and have secured better production in car repair work.

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**Co-operation in fuel economy**

The railroads have effected marked economy in the use of locomotive fuel in the past few months and, in fact, when expressed on a thousand gross ton-miles basis, including locomotive and tender, the fuel consumption in freight service was less during each month of 1925 than in the corresponding month of 1924, the average reduction being about 7 per cent, and 14 per cent as compared with 1923 figures. In passenger service also, the locomotive fuel consumption per passenger train car-mile in 1925 was approximately five per cent under that of 1924 and 12 per cent less than that in 1923.

This improvement was possible only by the co-operation of a large number of men in different branches of railroad service and among these are included many whose work is not ordinarily considered to have a direct bearing on fuel consumption. There is too great a tendency to consider enginemen and firemen responsible for unsatisfactory fuel consumption records, when possibly the best efforts of these men are being largely nullified by unnecessary train stops, train delays which could be avoided, fires knocked at terminals where locomotives could be run through, locomotives fired up and held under steam longer at terminals than necessary. Brakemen who are too tired to release brakes in yard service also have a direct influence on fuel consumption, in some cases causing engine slipping and in all cases undue wear on the equipment. It would be difficult to determine with exactness the coal wasted each time set hand brakes on cars being switched in yard service result in the slipping of locomotive drivers. In regard to this matter, however, W. L. Robinson, superintendent of fuel and locomotive performance of the Baltimore & Ohio, has the following interesting comment to make: "Assuming that on the average, three revolutions of the drivers will be made before the slipping is stopped, it is estimated that from 8 to 10 lb. of coal is wasted by the steam worked through the cylinders during each slipping period. In addition, the direct waste of coal by the tearing action on the fuel bed on the grates, making it necessary to level the fire, cover the holes or add coal to deepen the fuel bed, will probably amount to about the same quantity. Roughly, then, it may be said that on the average as much coal is wasted each time engines slip as is wasted by the pop valve being open for one minute, that is, from 16 to 20 lb. of coal."

Fuel economy is, and probably always will be, one of the most effective means of increasing railway operating efficiency. Definite performance marks should be set up as goals on the individual roads and an unremitting campaign carried on to stimulate interest and continue the good work now being done in the way of saving fuel.

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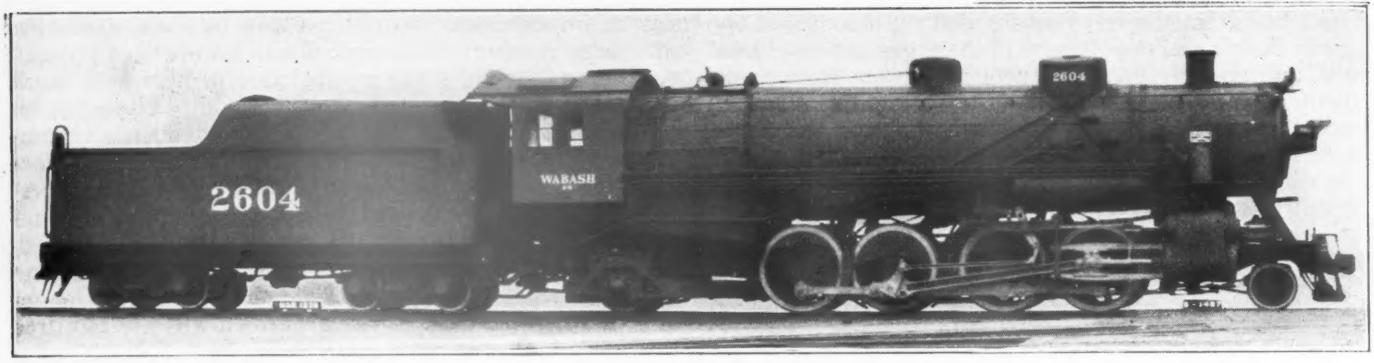
# New Books

AN INVESTIGATION OF THE FATIGUE OF METALS. *Bulletin No. 152 University of Illinois. By H. F. Moore and T. M. Jasper, Published by the Engineering Experiment Station, University of Illinois, Urbana, Illinois. Bound in paper, 6 in. by 9 in. 92 pages, illustrated. Price 50 cents.*

This bulletin is the report of an investigation conducted by the Engineering Experiment Station, University of Illinois, in co-operation with the National Research Council, the Engineering Foundation, the General Electric Company, the Allis-Chalmers Manufacturing Company, the Copper and Brass Research Association, and the Western Electric Company. The investigation was conducted by H. F. Moore, research professor of engineering materials, in charge of the investigation of fatigue of metals, and T. M. Jasper, research associate professor of the same department. It includes a description of the tests, apparatus, specimens used and results, together with a discussion of these results in relation to the general subject of the fatigue of metals. The tests include an investigation of the fatigue strength and static strength of steel at elevated temperatures, magnetic analysis as a test for fatigue strength of steel, fatigue strength of non-ferrous metals and case-carburized steel, and a discussion of the merits of the testing machines used for repeated stresses. The bulletin contains a number of charts, diagrams and illustrations of value to one who is interested in the fatigue of metals.




*Wabash three-cylinder Mikado Type Locomotive*

# Three-cylinder locomotives discussed by Chicago engineers

*Operating results on the Wabash—Analysis of effect of three-cylinder principle on capacity and economy*

THE three-cylinder locomotive was the subject of discussion at the regular monthly meeting of the Chicago section of the American Society of Mechanical Engineers, held at Chicago, February 24. Papers were presented analyzing the effects of the three-cylinder principle on locomotive capacity and economy, on track stresses, and on the general wear and tear of the locomotive, and outlining the actual experience of two railroads with three-cylinder locomotives. In addition to the two papers abstracted below, a brief summary of tonnage tests conducted by the Union Pacific with a 4-10-2 type, three-cylinder locomotive was presented by E. L. Woodward, associate editor of the *Railway Mechanical Engineer*.

The paper by W. A. Pownall, mechanical engineer, Wabash, is of particular interest because of the considerable amount of information it contains bearing upon the question of three-cylinder locomotive maintenance.

## Three-cylinder locomotive operation on Wabash

*By W. A. Pownall*

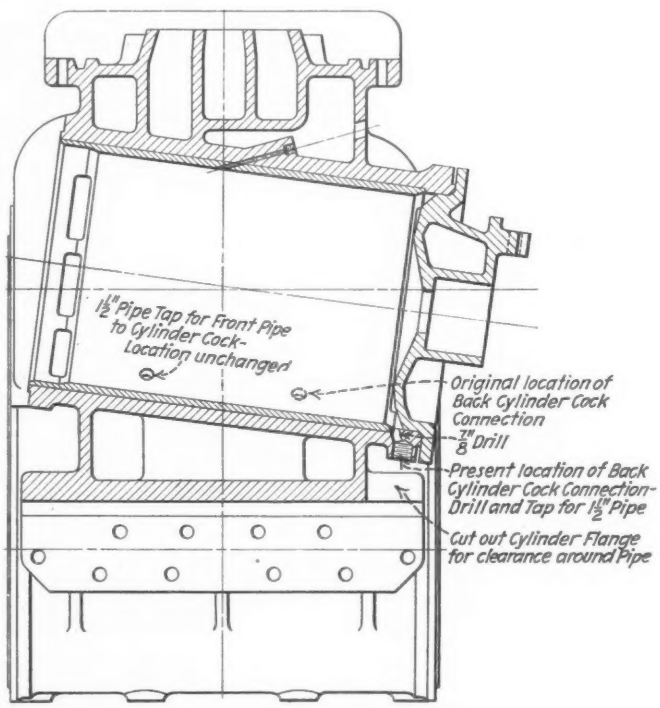
*Mechanical engineer, Wabash, Decatur, Ill.*

About a year ago 50 heavy Mikado type freight locomotives were built for the Wabash by the American Locomotive Company, Schenectady, N. Y. Before ordering these 50 engines considerable thought was given to the advantages claimed for the three-cylinder type. The performance of three-cylinder engines in service was investigated, and it was decided that while 45 of the 50 would be of the usual two-cylinder type the other five would be of the three-cylinder type.

The advantages which were expected from the three-cylinder engines as compared with the two-cylinder were briefly as follows:

*Mechanical*—Reduction of stresses on pistons, crossheads and rods due to dividing the load among three sets of parts instead of two. Less severe strains in main frames, axles and other parts of the locomotive because of more even distribution of the load or work transmitted from the cylinders through the axles, rods, wheels, etc. Less reciprocating weight to counterbalance, resulting in lessening the hammer blow on the rail as well as side thrust or "nosing" of the engine. Less damage to freight cars due to smoother starting of heavy trains.

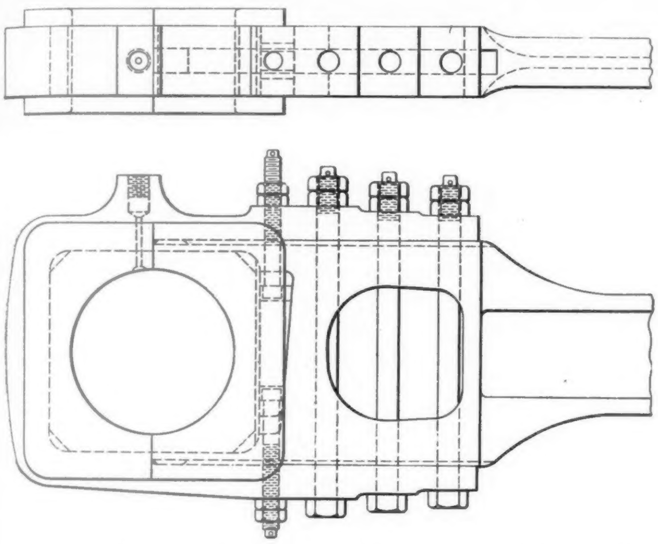
*Operating*—Increased tonnage per train or increased speed with the same tonnage, and a saving in fuel and water. Less slipping of the engine when starting heavy trains or with slippery rail conditions. Decreased track and bridge maintenance due to lower dynamic augment and nosing of engines.




**Longitudinal section through the inside cylinder, showing the change in the rear cylinder cock location**

### Close adherence to heavy Mikado design

In preparing specifications for these engines the design of some Wabash heavy Mikados built in the previous year was closely followed, only such major changes being made as were necessary for the three-cylinder type for five of the lot. Arrangements were made for the other 45 to be readily convertible, if so desired at some future time, to three-cylinder engines with a minimum amount



Type of back end brass finally adopted for the inside cylinder on the Wabash

of change and expense. The principal change from the older, or class K-3 engines, consisted in increasing the distance between the second and third driver 13 in., the distance from the center of the cylinder to the engine truck wheel 4 in., and from the rear driver to the trailer 6 in., this last being due to an increase of 6 in. in firebox length rather than to any feature of the three-cylinder design. The 13-in. increase in distance between the second and third drivers was necessary in order not to have too short a middle main rod as well as to get proper angularity of this rod and clear the first and second axles. The engine truck was advanced 4 in. in order to provide necessary space in front for the valve gear for the center cylinder of the three-cylinder engine. The resultant increase in engine wheel base over the older engines was from 37 ft. 2 in. to 39 ft. 1 in., or 23 in. The main rod length was increased 10 in., and it was necessary to offset the center of the second driving axle in order to provide proper clearance for the center main rod.

These increases in wheel base cause little difference in appearance between the two and three-cylinder types. If at some time in the future the merits of the three-cylinder type justify conversion of the two-cylinder engines, it will be necessary to change only the cylinders, crossheads, valve gear, second and third driving axles and add necessary parts for the additional center cylinder.

These three designs of engine will be referred to as follows: class K-3 covers the two-cylinder type put in service early in 1924; class K-4 covers the 45, two-cylinder type, and class K-5 the five three-cylinder type, placed in service in 1925. The K-3 and K-4 have 27-in. by 32-in. cylinders while the K-5 has the two outer cylinders 23 in. by 32 in. and the center cylinder 23 in. by 28 in. in diameter and stroke.

The K-4 and K-5 carry 5 lb. more boiler pressure than the K-3, and the tractive forces developed are: K-3, 60,416 lb.; K-4, 61,965 lb.; K-5, 64,637 lb.

For comparison the following table shows the principal dimensions of these three classes:

| Class | Two-cylinder type K-3 | Two-cylinder type K-4 | Three-cylinder type K-5 |
|---|---|---|---|
| Cylinder diameter and stroke | 27 in. by 32 in. | 27 in. by 32 in. | 2, 23 in. by 32 in.<br>1, 23 in. by 28 in. |
| Steam pressure | 195 lb. | 200 lb. | 200 lb. |
| Diameter of drivers | 64 in. | 64 in. | 64 in. |
| Tractive force, lb. | 60,416 | 61,965 | 64,637 |
| Factor of adhesion | 3.94 | 4.01 | 3.87 |
| Weights, lb. | | | |
| Drivers | 238,000 | 248,450 | 251,215 |
| Front truck | 31,000 | 30,810 | 33,110 |
| Trailer truck | 56,000 | 54,470 | 56,165 |
| Total engine | 325,000 | 333,730 | 340,490 |
| Tender loaded | 196,500 | 194,500 | 194,500 |
| Engine and tender | 521,500 | 528,230 | 534,990 |
| Cylinder horsepower | 2,558 | 2,624 | 2,856 |
| Heating surface, sq. ft. | | | |
| Firebox | 273 | 309 | 309 |
| Arch tube | 32 | 32 | 32 |
| Tubes | 2,660 | 2,660 | 2,660 |
| Flues | 1,224 | 1,224 | 1,224 |
| Total | 4,189 | 4,225 | 4,225 |
| Superheating | 1,051 | 1,051 | 1,051 |
| Grate area, sq. ft. | 66.7 | 70.2 | 70.2 |
| Mechanical stoker | Duplex | Duplex | Duplex |

It will be noted that the K-5, with a slightly greater weight on drivers than the K-4, has an increase in tractive force of 2,672 lb., or 4.4 per cent, and a noticeably lower factor of adhesion. Thus, advantage has been taken of the feature of more even turning movement of the three-cylinder type of engine to use a lower factor of adhesion and obtain an increased tractive force or hauling capacity at slight increase in weight of engine and without having a "slippery" engine. The results in actual service will be touched on later.

The five three-cylinder engines were placed in service during April and May of 1925, and were assigned to fast merchandise freight trains running between St. Louis and Chicago. A good proportion of the distance is double

| From | Cars | Tons | Miles | Time, hrs. and mins.: Between terminals | Time, hrs. and mins.: Delay | Time, hrs. and mins.: In motion | Speed, m.p.h.: In motion | Speed, m.p.h.: Between terminals |
|---|---|---|---|---|---|---|---|---|
| St. Louis to Decatur | 50 | 2,019 | 108 | 3—50 | — 6 | 3—44 | 28.9 | 28.2 |
| Decatur to St. Louis | 75 | 2,430 | 108 | 4—53 | —54 | 3—59 | 27.1 | 22.1 |
| Decatur to St. Louis | 60 | 1,991 | 108 | 3—50 | —27 | 3—23 | 31.9 | 28.2 |
| Decatur to Chicago | 40 | 1,675 | 168 | 6—40 | —55 | 5—45 | 29.2 | 25.2 |
| Decatur to Chicago | 50 | 1,874 | 168 | 7—40 | 1—48 | 5—52 | 28.7 | 21.9 |
| Decatur to Chicago | 52 | 2,046 | 168 | 6—32 | 1—25 | 5—07 | 32.8 | 25.7 |

track road, the ruling grade from St. Louis to Chicago is 0.6 per cent for the first 25 miles and 0.4 per cent for the balance of the way, and is 0.8 per cent, 0.7 per cent and 0.3 per cent from Chicago to St. Louis. Usually the heavy business is coal northbound, handled in 5,000-ton trains by 2-10-2 type engines, but the merchandise trains are necessarily of comparatively light tonnage in order to make the required speed, particularly to Chicago, where early morning deliveries must be made. Their average speed in motion is about 27 miles an hour. No attempt is being made to make long runs with these engines, and they are operated from East St. Louis, Ill., to Decatur, 108 miles, and from Decatur to Chicago, 168 miles. The northbound trains leave East St. Louis early in the evening and are due in Chicago, 276 miles away, at 4 o'clock the next morning. A few examples of these runs with the three-cylinder engines are shown here.

If the trains are late out of the terminal, or meet with unusual delays, they make considerably higher speed than shown in this table in order to get in on time. I rather hesitate to use the term "high speed" here, for undoubtedly some of the railroad men present have in mind right now some faster trains on their roads. However, most of the roads have some time freight trains that they watch particularly, and if the conditions are in any way similar to ours, the performance figures herein furnished may give a basis of comparison.

During 1924, these same time freight trains were handled partly by the class K-3 engines, which are, as already shown, very similar to the three-cylinder engines, and by our class L-1 engines, which are the 2-10-2 type

with 71,485 lb. tractive force. Fuel performance records are kept by individual engine and engineman, the amount of coal used being taken from engineman's coal tickets, and the train tonnage, etc., from the car accountant's records. Information taken from these fuel records and covering the performance of the three-cylinder engines from May to November, 1924, and for the two-cylinder engines for the same trains and corresponding months in 1925 shows the following comparison:

| Class | L-1 | K-3 | K-5 |
|---|---|---|---|
| Type | 2-10-2 | 2-8-2 | 2-8-2 |
| Cylinders | two | two | three |
| Total trips | 368 | 677 | 1,078 |
| Average tons per train | 1,937 | 1,714 | 1,853 |
| Lb. coal per 1,000 ton-miles | 136.8 | 118.6 | 113.6 |
| Per cent saving, three-cylinder Class K-5 over two-cylinder Class L-1 | .......... | .......... | 16.96 per cent |
| Per cent saving, three-cylinder Class K-5 over two-cylinder Class K-3 | .......... | .......... | 4.2 per cent |

These records show that the three-cylinder class K-5 engine handled time freight trains averaging 8.1 per cent heavier than the trains handled by the class K-3 two-cylinder engine of similar proportions during the corresponding period of previous year, and at a coal consumption of 4.2 per cent less on the ton-mile basis. The average train for the three-cylinder class K-5 was 55 cars, as compared with 45 cars for the class K-3. As compared with the 2-10-2 type, the three-cylinder engine fuel performance was 16.96 per cent better. The less favorable fuel showing of the 2-10-2 engine was probably due in a measure to these engines being somewhat heavy for this particular class of service, which would result in an increased fuel rate on the ton-mile basis. However, the three-cylinder engines did the time freight work previously done by the two-cylinder 2-10-2 type and class K-3 engines, and at a fuel saving of 10.4 per cent over the combined performance of the two-cylinder engines. There would not be so much difference in point of cut-off between two and three-cylinder engines in fast freight service since with both types the cut-off is comparatively light, but with full tonnage trains the three-cylinder engine would work at materially less cut-off, resulting in a greater per cent of fuel saving than shown here for fast freight service.

The figure of 113.6 lb. of coal per 1,000 ton-miles may look rather high in the light of not infrequent instances of 60 to 80 lb. per 1,000 ton-miles in drag freight service, but it should be remembered that the high speed demanded in the time freight service and the fact that the average train is perhaps less than 50 per cent of the dead freight tonnage rating are against a favorable fuel performance. Our records given here are for similar service and show favorably for the three-cylinder engines.

### Road men favor three-cylinder type

These engines have now been in continuous service for about nine months. The opinions of the road foremen of engines and fuel supervisors have been asked for from time to time and I quote a few:

"At high or low speed the three-cylinder engine gets the train going quicker and rides better than the two-cylinder engine."

"It is easier for a three-cylinder engine to start a train without taking slack, and therefore causes less damage to draft gears."

"Any train that can be started can be run at a more uniform rate of speed and handled better over the hills."

"There is a saving in fuel and water over the two-cylinder engine."

"Train can be handled at 33 to 35 per cent cut-off where a two-cylinder would have to be worked at or near 50 per cent cut-off to handle same train."

Although the three-cylinder engines have been used mostly in this fast freight service, tonnage ratings for drag freight have been established from dynamometer car tests. A comparison of the rates thus established for the two-cylinder and three-cylinder engine is given here:

| From | To | Ruling grade, per cent | Adjusted rating, tons: Two-cylinder | Adjusted rating, tons: Three-cylinder | Car factor | Per cent increase three-cyl. over two-cyl. |
|---|---|---|---|---|---|---|
| East St. Louis | Worden, Ill. | 0.6 | 4,130 | 4,360 | 7 | 5.6 |
| Forrest, Ill. | Chicago | 0.4 | 4,990 | 5,210 | 11 | 4.4 |
| Chicago | Brisbane, Ill. | 0.9 | 3,260 | 3,585 | 5 | 10.0 |
| Brisbane, Ill. | Decatur, Ill. | 0.7 | 3,670 | 4,175 | 6 | 13.8 |
| Mt. Olive, Ill. | East St. Louis. | 0.3 | 6,240 | 6,510 | 12 | 4.3 |

The three-cylinder engines have 4.4 per cent greater tractive force than the two-cylinder, and where the ruling grade was 0.4 per cent and the train was kept moving, the tonnage rating increase was the same as the increased tractive force, that is, 4.4 per cent. However, on the steeper grades, which on these districts are usually momentum grades, the three-cylinder engine seemed to keep the train moving at a better speed on the first part of the hill, and it was possible to establish ratings somewhat greater than the two-cylinder engine ratings than the difference in tractive force justified. For example, the rating from Chicago to Brisbane was increased 10 per cent and from Brisbane to Decatur 13.8 per cent.

The three-cylinder engine admittedly possesses advantages from the mechanical and operating standpoint, but a serious question in many minds was whether the additional maintenance or increase in mechanical failures due to the extra parts and unusual features of design would not more than offset these other advantages. Past experience with engines having relatively inaccessible parts has been unfavorable in that these parts did not receive proper attention, resulting in road failures and ultimately rather heavy maintenance costs.

Although our five engines of this type have only been in service about nine months, and have not yet been in the shop for classified repairs, there has thus far been, with the exception of some middle main rod trouble, no more running repair work than on similar size engines of the two-cylinder type. The following table shows the mileage these engines have made each month in freight service, and these mileages are good evidence that the engines have not been spending much time in enginehouses undergoing repairs.

Twelve of the two-cylinder engines (class K-4) averaged 4,164 miles per month on an adjacent division.

**Monthly mileage of three-cylinder locomotives on the Wabash**

| Month | No. 2600 | No. 2601 | No. 2602 | No. 2603 | No. 2604 |
|---|---|---|---|---|---|
| May | 5,572 | 3,598 | 5,205 | 3,260 | .... |
| June | 4,504 | 2,978 | 5,166 | 4,552 | 4,578 |
| July | 4,968 | 4,641 | 4,398 | 4,384 | 5,160 |
| August | 5,664 | 4,644 | 4,992 | 4,532 | 2,668 |
| September | 4,464 | 4,798 | 4,764 | 4,769 | 2,182 |
| October | 6,264 | 5,028 | 4,522 | 4,854 | 3,552 |
| November | 5,616 | 3,840 | 4,376 | 4,684 | 4,800 |
| December | 5,002 | 4,850 | 3,360 | 4,560 | 4,530 |
| Total | 41,054 | 34,377 | 36,983 | 35,686 | 27,470 |
| Average per month | 5,132 | 4,297 | 4,623 | 4,461 | 3,924 |

Average per month per engine, 4,492 miles.

The matter of suitable middle main rod design, particularly the back end, has given the builders some concern. After our engines had been in service about six weeks we had some reports that the back end of the middle main rod was pounding. We had had more or less success with the use of the floating bushing for the middle connection of side rods and had decided to use this type of bushing for the back end of the middle main rod for the three-cylinder engines. The bushing was applied in three sections, the back end of the main rod being necessarily of strap construction since the solid back end main rod could not be applied to the crank axle.

The sections of the brasses first applied were $\frac{1}{16}$ in. between the ends, or a total of $\frac{3}{16}$ in. for the three openings, and the brasses were also applied so as to allow $\frac{1}{8}$ in. side play. The result of this side play and the

openings between the ends of the brass was more or less side slap and noise, which contributed to the complaints about rods pounding. The straps were attached to the rod with three bolts, and we had a little trouble on account of these bolts shearing, and had one actual engine failure due to a broken strap. However, this failed strap was traced to a defect in material. In view of this experience, we were not entirely satisfied with the floating bushing application, and it was decided to apply sectional brasses similar to the usual sectional brass used on the outside main rods. Two of the five engines were thus equipped. The other three engines continued to use the floating bushings, but with only 1/32 in. of lateral play and with the ends of the sections 1/32 in. apart instead of $\frac{1}{16}$ in., giving a total end clearance of 3/32 in. instead of $\frac{3}{16}$ in.

### Water in third cylinder caused trouble

In the meantime we noticed more or less trouble with leaking of the center cylinder piston rod packing, and investigation indicated that this was due to water in the cylinder. There were two cylinder cocks for the center cylinder, and with this installation it was found that water not only accumulated in the passage leading to the cylinder, but could also accumulate in the back end of the inclined center cylinder. The cylinder cock location was changed to take care of this accumulation of water. The front cylinder cock was left in its original position. The back cylinder cock hole was plugged and the cylinder cock relocated so as to take the water from the lowest point of the center cylinder. The cylinder cocks are air operated so as to do away with the objection of long cylinder cock rigging from cab to cylinder.

Since making the change in cylinder cocks we have had little or no trouble with any of the main rods or with piston rod packing leaking, whether the engines are equipped with the sectional brass or with the original floating bushings. However, our records show that thus far the floating bushings have been renewed at an average mileage of 9,600, and frequently it has been advisable to renew the back end rod bolts at about the same interval. The two engines with the sectional brasses have had the brasses reduced on an average, once every 15,000 miles, the reduction each time being only 5/64 in. In view of the fact that floating bushings have to be renewed four or five times between shoppings, whereas the sectional brass may last from shopping to shopping with two or three "reductions," the expense of middle main rod brasses is considerably in favor of the sectional brass. This should not be construed as being against the floating bushings for outside rods, but is simply giving the results of our experience with different types of back end main rod brasses for center cylinder of our three-cylinder locomotives. We are inclined to favor the sectional brass rather than the floating bushing, but believe that what trouble we had with the main rod was probably due to water rather than to any improper or impractical design of main rod parts.

Summing up our experience with five locomotives of the three-cylinder type, I would say that:

1—Maintenance will not differ materially from the two-cylinder type. It will possibly be less over a longer period of time.

2—From the standpoint of train operation the three-cylinder engines will do better than the two-cylinder type.

3—The three-cylinder engine will make a moderate saving in fuel and water in fast freight service, probably more in drag freight service.

4—Enginemen and supervisory forces are, in general, well satisfied with the three-cylinder locomotives.

# Effect of three cylinders on locomotive capacity

*By J. G. Blunt*

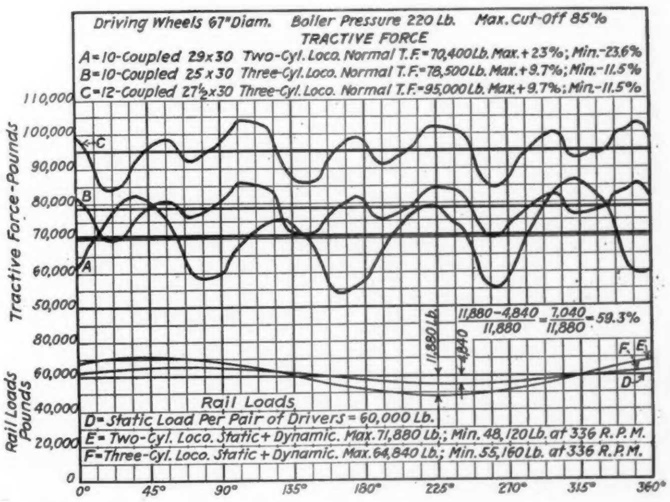
*Mechanical engineer, American Locomotive Company, Schenectady, N. Y.*

There are many explanations why the power is increased in the three-cylinder locomotive. The six cylinder-impulses per revolution of the driving wheels, by giving a more even turning moment, raise the low point of the tractive force curve, thus increasing the starting force and likewise, by lowering the high point, reduce the slipping tendency. This enables us to reduce the coefficient of adhesion. From 10 per cent to 15 per cent may thus be gained in normal tractive force, with from 20 per cent to 30 per cent increase in starting effort, thus giving a large tonnage capacity increase, with more rapid acceleration. One prominent road now using three-cylinder locomotives has continuously obtained a full 20 per cent normal tractive force increase, which means 40 per cent greater starting effort. We are thus enabled largely to increase the capacity of the locomotive and keep within specified weight limitations.

A two-cylinder locomotive is practically limited to five-coupled axles on account of the excessive counterbalance weight requirements, while the three-cylinder locomotive, with its lighter reciprocating weights and the ability to couple the outside cylinders to other than the crank axle, enables us, with much better balancing conditions, to use six coupled axles, thus adding another 22 per cent to the normal tractive force of the largest practical locomotive. We therefore can add, as the very lowest estimate, a total of 32 per cent to the normal tractive force, likewise increasing the starting force by at least 64 per cent. Tests have demonstrated the great power flexibility in the three-cylinder locomotive with slight changes in valve setting to meet the varying demands of starting effort, sustained power, speed and economy of fuel.

### Dynamic effects on track 60 per cent less

With the more perfect counterbalancing, the dynamic effects on the track are calculated for the three-cylinder




**A comparison of the tractive force and dynamic rail loads of two-cylinder and three-cylinder locomotives**

locomotive as a whole to be approximately 60 per cent less than in an equivalent two-cylinder locomotive. Therefore, a 10 per cent increase in static load per driving axle would seem reasonable, as the dynamic effects would,

with such increase, still impose lower stresses on the track and bridges.

This would make possible a normal tractive force increase at least 35 per cent greater than in the largest possible two-cylinder locomotive, while having a starting power at least 70 per cent greater. I am informed by some users of the larger three-cylinder locomotives that this is far too conservative a claim, greater power percentages being more easily obtained in the larger units than with those of medium size.

As an example, assume a two-cylinder locomotive having cylinders 29 in. diameter by 30 in. stroke, 67 in. diameter drivers, 220 lb. steam pressure, five coupled axles, having a normal tractive force of 70,400 lb., with a minimum starting force of 56,320 lb. This same locomotive, if built as a three-cylinder locomotive, with cylinders 25 in. diameter by 30 in. stroke, 67 in. wheel and 220 lb. steam pressure, would have a normal tractive force of 78,500 lb., with a minimum starting force of 70,650 lb. and approximately the same slipping tendency. Add to this three-cylinder locomotive a sixth pair of coupled driving wheels, making it possible to use three 27½-in. diameter by 30 in. stroke cylinders, with 67 in. drivers, 220 lb. steam pressure, and we have a normal tractive force of 95,000 lb., or a minimum starting force of 85,500 lb. These comparisons are made on the basis of only 10 per cent normal tractive force increase in the three-cylinder locomotive over its equivalent two-cylinder locomotive. With a 20 per cent increase, the normal tractive force would be 103,600 lb.

Another striking comparison shows this two-cylinder locomotive in working order to weigh approximately 5.75 lb. per pound of tractive force developed, while in the six-coupled locomotive it would weight about 5.14 lb. per pound of tractive force developed, or 109 lb. per horsepower.

The representative of a leading English railway using many three-cylinder locomotives claims to obtain 16 per cent greater normal tractive force than in equivalent two-cylinder locomotives, with no more tendency to slip and with no more weight on the coupled wheels, while the minimum starting force is 30 per cent greater. These statements apply to comparatively small locomotives where, apparently, no attempt has been made to construct the most powerful unit.

### Greater speeds possible

A three-cylinder locomotive is capable of more speed than a two-cylinder locomotive, due primarily to more perfect counterbalancing following the use of lighter reciprocating parts, which is very clearly exemplified in the test of a Missouri Pacific three-cylinder 2-8-2 type locomotive built by the American Locomotive Company, a report of which appears in the *Railway Mechanical Engineer* of July, 1925, the test having been conducted on the Altoona testing plant of the Pennsylvania.

Another most important influence on speed is the ability of the locomotive to negotiate curves, which is largely influenced by the degree and efficiency of the lateral resistance offered by the engine truck, trailer truck and other lateral motion or resistance devices. Generally speaking, the curving ability of a locomotive at higher speeds is best effected by means which gradually increase the resistance of each pair of truck or driving wheels leading up to or near the center of rotation of the locomotive mass in order to deliver the least severe shocks to the frame structure of the locomotive, tire flanges, rails or right-of-way. Locomotives capable of making the highest speed with safety should, furthermore, be suspended in such a manner as to maintain the maximum lateral stability against rolling.

It is well to remember, by way of comparison, that the boiler efficiency is much lower in a two-cylinder compound locomotive than with a corresponding two-cylinder simple engine, due to only one-half the number of exhaust impulses acting on the fire, although in the case of the compound locomotive the steam consumption may be much less. This shows one phase in the relative effects on fuel economy with the six exhausts per revolution of driving wheel in a three-cylinder as compared with the four exhausts in the two-cylinder locomotive. The exhaust tip may be relatively larger in a three-cylinder locomotive, thereby causing less back pressure. The marked increase in starting force of the three-cylinder locomotive enables the engine to operate a greater percentage of its running time in shorter cut-off and, therefore, more economically than the two-cylinder locomotive.

### Union Pacific tests show 16.2 per cent fuel saving

In a comparative test conducted by the Union Pacific, as between a two-cylinder Santa Fe type engine with 74,941 lb. normal tractive force, and a three-cylinder 4-10-2 type locomotive with 78,000 lb., by equating the slight tractive force difference, the three-cylinder locomotive showed 20 per cent increase in power and used 16.2 per cent less coal per thousand gross ton miles hauled.

Few reports are available showing the comparative mileage between general repairs of three-cylinder locomotives and two-cylinder locomotives of about the same class and in similar service, but it is evidently much increased in the three-cylinder locomotive due to the better counterbalance and more even distribution of power to the frame structure by having one-third of the cylinder power between the frames and ability on some types to attach the outside cylinders to other than the crank axle. Records from English roads show from 7 per cent to 25 per cent increase in favor of the three-cylinder locomotive.

In 1923 the United States Department of the Interior showed that public utility power plants in the United States generated 36,092,000,000 kw. hours from plants using coal, oil or gas equal to 43,522,000 tons of coal. This is equivalent to 1.8 lb. of coal per indicated horsepower per hour, although a few of the very latest use but 1.2 to 1.4 lb.

It has been carefully computed that the best modern two-cylinder steam locomotives will develop a drawbar horsepower per hour on an average of between 2.55 and 2.77 lb. of coal exclusive of auxiliaries, and at the rate of from 2.81 to 3.11 including auxiliaries. An indicated horsepower hour may likewise be developed for between 2.35 and 2.57 lb. exclusive of auxiliaries, or from 2.61 to 2.91 lb. including auxiliaries.

### Only 2.20 to 2.60 lb. of coal required per hp.-hr.

The three-cylinder locomotive will use from 2.20 to 2.60 lb. of coal per drawbar horsepower per hour exclusive of auxiliaries, or from 2.50 to 2.90 lb. including auxiliaries. An indicated horsepower will be developed from 2 to 2.4 exclusive of auxiliaries and from 2.20 to 2.60 including auxiliaries.

Experience has demonstrated that the three-cylinder locomotive reduces track stresses and maintenance. A careful check will, without doubt, show reduced tire wear for the three-cylinder locomotive, as it has done in foreign countries. Assuming this as a fact, this should correspondingly increase the life of the rail, showing large indirect economies that would follow its more general use.

No sincere advocate of the three-cylinder principle will claim perfection for it more than in other types of loco-

motives but careful analyses, reinforced by actual test, unmistakably indicate that the advantages to be gained far outweigh the disadvantages and afford an opportunity for effecting large economies in operating a railroad when the most powerful individual units are a factor.

Compounding in connection with the three-cylinder application offers possibilities from the standpoint of steam economy, the necessity for which will be more pronounced as boiler pressures are increased, but if generally adopted must be accomplished without appreciably affecting the maintenance problem or causing a marked recession in the power or speed features.

The many devices now on the market for effecting fuel economy and increasing tractive force have done about all that can be expected to increase the capacity of the two-cylinder locomotive and where still greater and more economical steam power units are required, the inevitable step is to adopt the three-cylinder principle with the determination to make use of the many advantages its design offers.

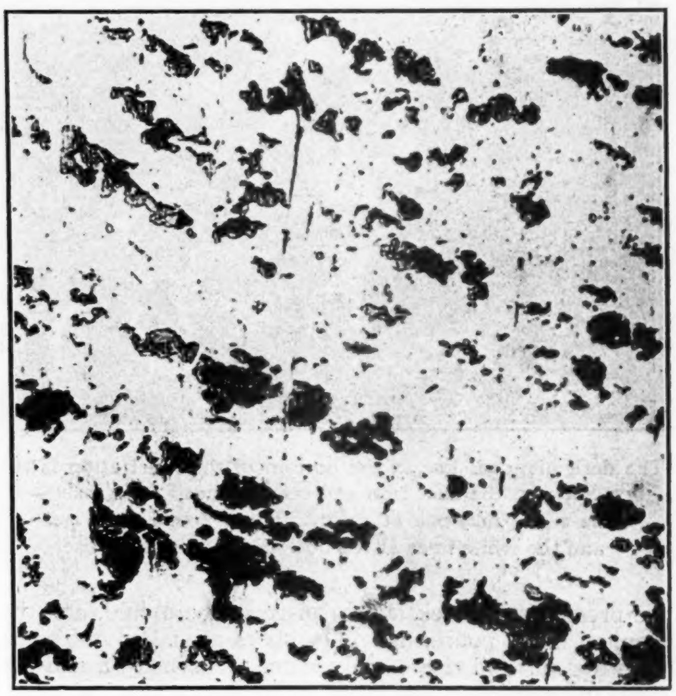
# Comparative tests of cast iron brake shoes

## Shoes having an expanded metal insert are found to give more economical service

*By Fred H. Williams*
*Assistant test engineer, Canadian National Railways, Montreal, Que.*

A NUMBER of extensive tests made by several large railroads in the United States and Canada, show that a cast iron shoe with a steel back and expanded metal insert give a much better wearing shoe and equally good, if not better, frictional value and in the long run a more economical brake shoe than either the plain cast iron shoe or the partially chilled shoe. The first cost of this shoe with the expanded metal insert is more than the ordinary plain or chilled cast shoe having a steel back. Shoes without the steel back are not permitted under the rules of interchange of the A. R. A. The economy of the expanded metal insert in the brake shoe has been clearly demonstrated by both service and laboratory tests. The expanded metal insert increases the wearing quality so much that a shoe with the insert will outwear two or three plain cast iron shoes. Furthermore, breaks are more likely to occur when the supporting reinforcement is missing.

**Photomicrograph of an expanded metal insert shoe, showing the cast iron at the top (dark) with the line where the cast iron meets the expanded metal with the metal of the insert below**



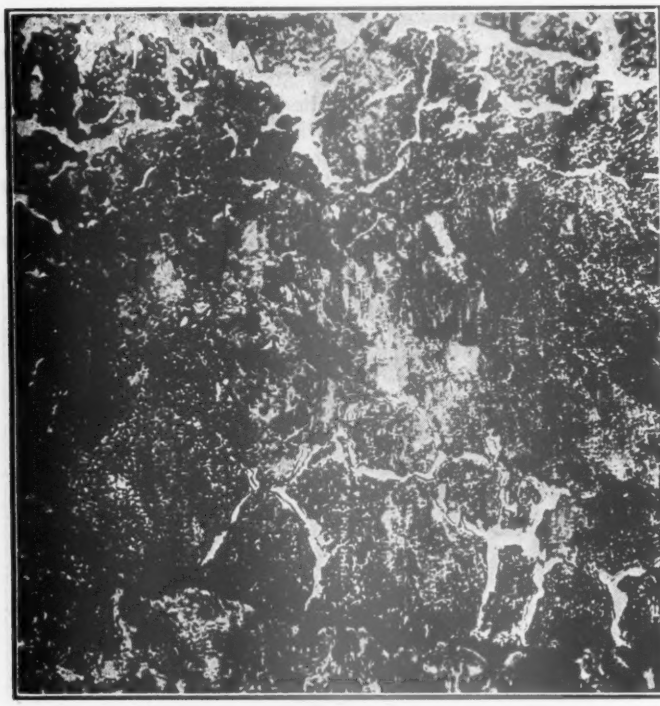
**The structure of the steel insert before the heat and carbon of the molten iron has changed its original structure**

There are several governing features that limit the use of the brake shoe and effect its design. But it is not the intention of the writer to discuss the design of the shoe, which is recommended by the American Railway Association. It is quite evident that the design of the present

brake shoe is the result of much study, both theoretical and practical, and the standard shoe is quite within the limits of perfection as far as size and other details go. It is, however, the intention of the writer to consider carefully those features that are embodied in the material used in the brake shoe in so far as it relates to plain cast iron, chilled cast iron and shoes having the expanded metal insert. No consideration is given to other types of shoes, which may have more or less merit but have not as yet come under the observation of the writer.

The governing features of a good brake shoe are safety, first cost, wearing qualities, frictional value, maintenance cost, service and efficiency. But before considering these it would be well to give a brief description of the three principal types of brake shoes and also to mention that a detailed study of the structure of the shoe containing the expanded metal insert has been made with the microscope and photo-micrographs, some of which are illustrated in this article, which shows the essential features of structures. There are also shown photo-micrographs of the plain cast brake shoe structure in some of the illustrations.

The plain cast iron brake shoe has a pressed steel back, brake shoes not having a steel back not being considered in this article. The shoe is made in accordance with standard A. R. A. design and is not chilled on the wearing surfaces. The mould is made in the regular way, with



**The dark diagonal line at the bottom of the illustration is the line between the cast iron and the expanded steel insert—The white network at the top is the free ferrite and and the white lines at the bottom the free cementite**

the pressed steel back laid in place in the mould, and the moulten metal poured in. The shoes are taken out when cool, the fins and risers broken, cut or burned off and the shoes inspected.

The metal or mild steel back is made in various shapes, designed to prevent fractures or possible destruction of the shoe and to hold a steel lug used to fasten the shoe by means of a key to the brake head. These steel backs are punched and are generally formed from flat steel bars.

The cast iron in this type of shoe is a close grained gray iron having no white or chilled iron structure, except, possibly, around the steel back. This, however, is not of primary importance, unless it is excessive enough to cause cracks and a broken shoe.

The microscope structure of this shoe is mainly lamellar pearlite with an excess of cementite. Free graphite is found in thin flakes throughout the whole and there is no free ferrite. The Brinell hardness is from 200 to 300. Owing to the surface hardness of the shoe caused by the chilling of the shoe in the sand, the wearing quality of the shoe is better at the start of its life than it is when the shoe is worn a little. Thus a brake shoe of this type wears well when new but wears down more rapidly after being in service a short length of time. These plain cast

**The transition from the cast iron at the upper right corner to the original structure of the steel of the insert at the lower left corner**

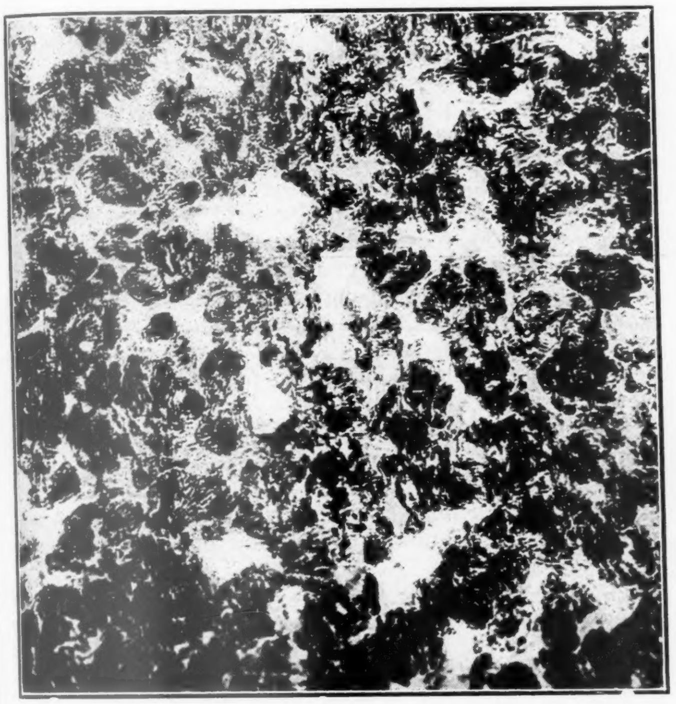
iron brake shoes are mostly used on freight cars except in the case of some roads which use a few on their passenger cars. The latter practice is not considered economical service.

The chilled cast iron brake shoe also has the pressed steel back and steel lug. It is made of similar cast iron except that the iron has qualities for a deeper chill. The difference in the manufacture of the two shoes is that chill blocks are placed in the mould of the chilled cast shoe so that the hot metal coming in contact with these metal surfaces is chilled on the ends of the brake shoe and from one to two inches of the wearing surface at each end. The rest of the surface is gray iron. This gives a shoe of proper frictional value and a good wearing face, having a wearing surface of about one-third white cast iron and two-thirds gray cast iron. This will vary somewhat depending upon the manufacturer.

The ratio of these two kinds of iron depends upon what the manufacturer considers will meet the requirements of the specifications to which the shoes are made. Care is taken to make these shoes of iron with a proper chemical content to give a good depth of chill and with this purpose in view, test bars are made from the iron coming from the cupola to ascertain the depth of the chill. This is accomplished by pouring the hot metal in a mould having chill blocks at the bottom. The bars are then broken

and the quality of chill noted. These chilled cast iron brake shoes are used on passenger and freight cars.

Cast iron brake shoes having an expanded metal insert are made with a pressed steel back similar to that previously described. These shoes differ because of the expanded metal insert which consists of a number of layers of expanded metal depending on the thickness of the shoe. They are tied together and dipped into a heat resisting mixture which protects the expanded metal. This bundle of expanded metal is then placed loosely in the mould and the hot metal is poured in, partially surrounding the pressed steel back and all of the expanded metal insert.



This photomicrograph shows the structure of the cast iron in the shoe with the expanded metal—Note the white iron which does not wear as rapidly as the softer irons and yet is softer than the cast iron wheel which is chilled

The expanded metal in the mould partially chills the molten metal as it comes in contact with it, leaving a cast iron of mottled structure. The expanded metal is slightly changed on one side and somewhat more on the side that first comes in contact with the molten metal. It is coated so as to protect it from being burned by the molten iron.

**Comparative table showing the cost and wearing qualities of cast iron brake shoes**

| | Plain cast iron | Chilled cast iron | Expanded metal insert |
|---|---|---|---|
| Wear in lb. per 1,000 wheel-miles | 1.73 lb. | 1.11 lb. | .72 lb. |
| Equivalent to per cent | 100 | 64.2 | 41.5 |
| Shoes used | 100,000 | 64,200 | 41,500 |
| Cost of shoes per ton | $52.00 | $57.00 | $67.00 |
| Weight, tons | 1125 | 722 | 467 |
| Scrap, tons | 500 | 321 | 208 |
| Cost of new shoes | $58,500 | $41,154 | $31,289 |
| Less scrap value @ $10.00 | $5,000 | $3,210 | $2,080 |
| Net cost of shoes | $53,500 | $37,944 | $29,209 |
| Cost of application 25c. each | 25,000 | 16,050 | 10,375 |
| Total | $78,500 | $53,994 | $39,584 |

Summary

| | |
|---|---|
| Saving per equivalent 100,000 plain cast iron shoes by the use of expanded metal insert in shoes | $38,916 |
| Saving per equivalent 100,000 plain cast iron shoes by the use of chilled cast iron shoes | 24,506 |
| Saving per equivalent 100,000 plain cast iron shoes by the use of expanded metal insert over chilled cast iron shoes | 14,410 |

The internal portion of the expanded metal does not change but retains the lines of rolling that were in the sheet before being expanded.

The foregoing briefly describes the three types of brake shoes. The steel backs cary in shape in each type only in details of design considered by each manufacturer to be necessary to improve the shoe. The main feature of the expanded metal insert is that it produces a mottled iron in the shoe and by its softness is supposed to retain particles of the cast iron as they are torn away and thus increase the life of the shoe. Both these features lengthen the life of the shoe without its being of excessive hardness.

The structures described are illustrated in the photomicrographs. A cross section of the shoe with the expanded metal insert shows the insert as a network of reinforcing steel, well surrounded with the mottled cast iron and free from excessive blowholes or spaces surrounding the expanded metal.

The service tests that have been made by several railroads in both the United States and Canada are too extensive to describe in full, but it is interesting to consider the relative values of these shoes, considering the first cost, wearing qualities, maintenance cost, and service cost, combining and finally showing the benefit of using the expanded metal insert in cast iron shoes.

This view shows the structure of the ordinary cast iron brake shoe not chilled

The figures shown in the table are the net saving and relative cost based upon prices of the shoes as bought in Canada, the prices are at Canadian rates and are given so that the saving based on other prices can be readily determined.

"Extra long eggs are the principal cause of egg breakage in transportation;" presumably meaning that long eggs, because of their length, do not fit well in the racks which are supposed to contain them and to keep each egg from disturbing its neighbor. This statement, taken from the Express Gazette Journal, is given as the opinion of men in the claim department of the American Railway Express. The editor says that the egg wisdom which he is here dispensing comes from a bulletin, by O. M. Wilbur, which has been issued by the University of Maine. Rhode Island Reds produce heavy eggs and Wyandottes are recorded as laying the smallest size. It is proposed that the hens should be invited to a conference on standardization.

# Future possibilities of the locomotive boiler

## Trend to high boiler pressures indicates a serious consideration of the watertube type

*By Louis A. Rehfuss*

IN the last 50 years, steam locomotive development has followed lines that have been conservative to say the least, save in the one item of increasing size. Most of the great developments really occurred prior to 1850. Since that time the designers have been conservative, yet hardly progressive. They have been content to refine, to elaborate, to improve the original design. There has been little disposition to go back and question the first principles, to determine whether or not the traditional type of steam locomotive was all that it might be. Of late locomotive design seems to indicate signs of a change.

In increasing the thermal efficiency of the steam power plant, the subject may be approached in two directions, up or down, widening the range from higher pressures to lower back pressures or vacuums. Recent experiments with turbine condensing locomotives have had to do with the extension of this range downward to work with vacuums with which the boiler has nothing to do, since it is a question of the utilization of the steam after it is made. On the other hand, with the extension of the range upward the boiler has a great deal to do, and it is with this phase that this article would treat.

### Trend toward higher pressures

The first steam locomotive successfully developed by James Watt, worked at a pressure of seven pounds. To-day the steam locomotive boiler operates at a pressure of 200 lb., and is apparently at its limit unless radical changes in its design are made. That these changes are at hand may be seen in the 350 lb. pressure locomotive boiler built for the Delaware & Hudson as well as in the 40 or 50 Brotan type boilers recently built for heavy railroad service in Hungary. These boilers dispense with the stayed back end and use walls of water tubes for the firebox, but still cling to heavy plate barrels, made heavier than ever to stand the pressure.

The whole reason for this trend towards higher pressures lies in the fact, that while the total heat to be imparted to a pound of water remains practically the same at all pressures, the heat of vaporization, which is never available as mechanical energy, steadily decreases as the pressure increases. This means that as the pressure rises a steadily increasing percentage of the heat is available as useful work. Theoretical savings, of course, are larger than practical, because of the greater condensation occurring at the higher temperatures used and other factors. Still with proper superheating to minimize the condensation and with normal precautions in design, undoubtedly the possibilties in increased thermal efficiency and coal economy point to increasing our boiler pressures to as great a degree as boilers and engines can be built to withstand them safely.

In the face of this plain trend of the future, what is the outlook for the steam locomotive boiler of to-day. Unfortunately the existing type will not lend itself readily to any considerable increase over present pressures, due to the question of the weight limitation on drivers and other factors.

With a barrel six or eight feet in diameter, locomotive boiler plates are already assuming alarming thicknesses and weights, so that even with a six-foot barrel, the thickness of boiler plate would be close to two inches for a 500-lb. pressure boiler, and nearly four inches for a pressure of 1,000-lb. With driving wheels already loaded to the maximum, doubling or tripling the weight of the present type of boiler through an increase in the pressure would soon impose a practical limitation to the extent of that pressure's increase. The difficulty of preventing heavier plates, where exposed to the fire, from burning would be another limitation.

It seems likely that the trend of the times is passing from a fire tube to a water tube type of boiler. This is partly foreshadowed in the D. & H. boiler and the Brotan boiler. Still higher pressures are likely to witness a still further application of water tube boiler principles on the barrel itself.

The reason for this is plain. Since the thickness of the plate varies as the diameter of the tube, barrel or drum holding the pressure, it is evident that a 3-in. tube with walls but ¼ in. thick will hold safely as high a pressure as a boiler barrel 6 ft. in diameter with walls several inches thick. Herein lies the solution of the difficulty, and herein lies the adaptability of the water tubes boiler to the high pressure steam locomotive of the future.

### Objections to a water tube boiler

Many objections may be raised to a conclusion of this kind, and particularly to the use of an all-water tube boiler. It seems worth while here to consider a few of them:

1—Will the joints stand the rack and tear of locomotive service?
2—How will radiation be prevented to the outside air?
3—How solve the high temperature difficulty?
4—Lessened water and steam capacity.
5—The question of safety.

The first objection likely to be raised is that the joints will not stand the rack of locomotive service. The present fire-tube locomotive boiler has approximately 200 tubes ranging from 15 to 20 ft. in length, which are absolutely unsupported except for rolling and beading at the ends. Suppose now the fire, or rather the furnace gases, are put outside the tubes and the water inside. This would not lessen the resistance of the joints to shock. If the weight of the water in the tubes increases the shock, there is still recourse to two expedients seldom used in locomotive boiler practice. The first is to place baffle plate supports at several points along the length of the tubes. With the furnace gases playing outside the tubes and therefore occupying a larger area, diverting the flames back and forth in their course is sound practice in water tube boiler construction. In a locomotive boiler, these baffle plates would help support the weight of the tubes

as well, thus preserving them from too great a strain from the effects of their own weight. Where tubes give trouble from slipping and are required to carry an unusual load, the slipping point can be easily raised by serrating with an ordinary tube expander, the rolls of which are grooved .007 in. deep, 10 grooves to the inch. A tube thus serrated would have its slipping point raised between three and four times its usual value.

A second objection to the use of the water tube boiler for locomotive service is the question of the radiation of the heat to the outside air. With the locomotive rushing through space this is plainly of the greatest importance. When using a water tube boiler the hot gases pass outside the tubes instead of through them, and this heat must be confined. An outside shell lined with firebrick offers the best solution to this difficulty. Even in the customary fire tube type of locomotive boiler, it seems strange that firebrick has not been used more in connection with the firebox.

### Objections to a waterleg type of firebox

The firebox construction of the D. & H. and Brotan locomotive boilers, in which water tubes are used for waterlegs, is an improvement over the stayed firebox side from the standpoint of improved circulation that keeps sediment from collecting. They are both inferior to straight firebrick walls, with water tubes used overhead in place of a crown, for several reasons.

The waterleg construction, in which the water cooled metal surface comes in contact with the fire itself, chills it and prevents it from burning to its best efficiency, causing coal only partially consumed to go in the ashes. The burning gases above, that are brought into premature contact with water cooled surfaces may well be lowered below the point of complete combustion, leaving valuable heat units to go up the stack. For these reasons it is not best to overload the firebox section with excessive water cooled area, even though such evaporative area, at the point of highest heat, is obviously most effective for evaporation.

By the use of firebrick walls, the evaporation that would be normally done by the waterlegs at the fire is simply transferred to the tubes, which become much more effective because of the higher temperature of the furnace gases. No evaporation is lost. Rather it is gained through the more thorough combustion of the coal possible with firebrick walls which reflect the heat instead of absorbing it. Evaporation in the firebox itself is not lost, since a nest of water tubes would be used overhead in place of the present unsafe crown sheet of the firebox.

It is also obvious that firebrick walls would prevent radiation to the outside air to a greater degree than is possible with the waterleg firebox. This can be understood from the fact that the heat conductivity of water is four or five times as great as that of firebrick. All told, a simple wrapper sheet lined with firebrick, with water tubes overhead, should be not only less expensive than an elaborately stayed firebox, but more effective in service.

In the case of a water tube boiler, firebrick could also be used to line the barrel, varied if desired, near the smokebox end by a circle of tubes carrying the feed water, which could be preheated and purified before entering into the boiler, while serving the purpose of preventing radiation to the outside air. For holding the firebrick lining, whether in the firebox or barrel, the key bricks could be molded with a bolt end projection, permitting them to be bolted fast to the walls of the shell. Overhead, the brick would rest on top of the top layer of tubes.

### Question of high steam temperatures

A third objection urged, not so much to the use of water tube boilers as to the use of high pressures, is the question of steam temperatures. Modern steam machinery is limited in its capacity to stand excessive temperatures. Even so, it is the practice to use high superheats, so that final temperatures of 600 deg. to 700 deg. are not unusual. Were no superheat used, these temperatures would correspond to saturated steam pressures of several thousand pounds. Steam at 500 lb. pressure in the saturated condition has a temperature of 470 deg. so we can still use a moderate superheat of 130 deg. and have but 600 deg. as the final temperature. Using saturated steam pressures of 1,000 lb. at 548 deg. there can be added still an initial superheat of 100 deg. and keep well inside the 700 deg. mentioned above.

In place of using a high initial superheat, the policy here would be to use a moderate initial superheat, expand the steam in two stages, which would be preferable with the high pressures employed, and superheat between the stages. Losses from condensation, one of the principal functions of superheating, would be thus overcome. Superheating at the intermediate stage would be more effective because the difference in temperature between the steam and the furnace gases would be the more pronounced.

A fourth objection to the use of water tube boilers for locomotive service is the lessened steam and water capacity involved. The area outside of the tubes now filled by the water in the fire tube boiler is greater than the cross sectional area of the tubes, so that the fire tube boiler of the same overall dimensions does have the greater steam and water capacity. However, because of this very fact, the average particle of water in the water tube boiler is at all times closer to its heating medium, so that steam can be obtained much quicker. In properly designed water tube boilers steam may be raised from a cold boiler to 200 lb. pressure in less than 30 min. This quick steaming makes large water and steam capacity unnecessary.

The necessity for high steam capacity is obviated by the use of high pressures. Thus a pound of saturated steam at 500 lb. pressure occupies but .90 cu. ft., contrasted with the 2.14 cu. ft. occupied by saturated steam at our customary 200 lb. pressure. When the increased power available in the higher pressure steam is also taken into consideration, it will be seen that the steam capacity with a 500 lb. pressure need be but a third that used in the normal 200 lb. pressure employed to-day, even without the advantage of the quick steaming already mentioned.

From the viewpoint of safety the water tube boiler has much to recommend it. Disastrous explosions where the whole crown sheet gives way, such as are yearly occurrences on locomotive boilers, are scarcely possible with water tube boilers. They are designed so that the steam and water drums are seldom brought into direct contact with furnace gases until after these gases have lost their power to do harm by contact earlier with a mass of water tubes.

The positive, swift circulation of the water, which is a feature of most water tube boilers is also one of their surest guarantees of safety. Not only does this circulation tend to keep all parts at a more equable temperature, but it also lessens scale deposition, which causes burning, while the upward surge of the water at the firebox end, where most of the steam is formed, prevents any section from being left dry from low water conditions. This same factor of superior circulation is one of the best features of water tube boilers as a whole. Besides promot-

ing safety, it positively increases the evaporative efficiency per square foot of tube surface.

The greater area of section occupied by the furnace gases around the tubes extends the combustion space, so that the tubes can be brought nearer the fire than might otherwise be deemed advisable. This greater area also lessens the friction encountered by the furnace gases in their path to the stack and decreases the necessity for high vacuum exhausts in the smokebox. Too easy a passage for the gases, which would result in their going up the stack at too high a temperature and wasting heat, is prevented by the appropriate use of baffle plates, diverting the gases back and forth across the tubes and lengthening the contact of the hot gases with the tubes.

The above are some of the many advantages that might be opened up by the use of water tube boilers in steam locomotive practice. Whether or not these advantages might be enjoyed without other great disadvantages would depend to a considerable degree upon the ability of the designer to make the best use of the limited areas within which he would be called upon to work. A water tube locomotive boiler could not reasonably depart very far in its general outside dimensions and shape from the present fire tube type. It would still have to be of limited cross section to meet clearance limits and extend itself principally in length.

# The moral side of apprentice training

## Too much emphasis cannot be placed on its importance and practical value

*By F. E. Lyford*
*Apprentice instructor, Lehigh Valley*

THE development of an apprentice school requires more than a consideration of the courses to be taught, equipment needed and rules for its operation. An investigation will show that to obtain the most good from such an organization, a study must be made of certain things which are sometimes overlooked. The operation of an apprentice school should be looked upon as a human engineering problem dealing with tremendously flexible, plastic material. The opportunities for molding this material along the light lines and giving young men a trade education are great, but often the matter of educational training is looked upon as of prime importance, whereas the moral training in co-operation, loyalty and square dealing should receive much thought.

The reason for the existence of an apprentice school is not merely its production of better trained men, for there are many other important results that should develop from its influence. These may be summed up as follows: The development of loyalty and co-operation, the discovery of supervisory material, the formation of the habit of thinking things out along the right lines, and the acquisition of a background of correct information, which tends to prevent the growth of a spirit of unrest and dissatisfaction, generally due to an ignorance of industrial relations. To provide even a few young men with such a background is a matter of benefit to a corporation.

The development of the school plan should consider the subjects to be taught, the equipment to be used and the scheduling of lectures in various lines, with the certainty that the supervisor of apprentices will realize the proper relation between technical training and the development of the moral issues spoken of above. An insistence on thinking problems through by applying correct principles, together with a course in industrial history and explanations of industrial relations, will produce men trained and capable of looking on both sides of questions arising between employer and employees, with some judicial ability to properly weigh the problems involved.

### Vital factors in apprentice training

Among the many things which contribute to the complete success of an apprentice school are the following factors: Personal contact, understanding the boys' point of view, especially in regard to their own dreams of what they have in mind for themselves; vocational guidance carried out as far as conditions allow; knowledge of the industrial problems confronting the apprentice; fairness and justice; keeping faith; a certain amount of contact of apprentices with superior officials, and giving the boys definite opportunities to assume certain responsibilities. These factors all deserve considerable study and in the following paragraphs, brief statements are made which explain what they mean, and touch upon effects which they produce on the successful operation of the apprentice school.

Personal contact means more than merely knowing each boy in the class room or shop. The outside interests which the outstanding boys have should receive the approval or disapproval and a little time spent with a few of the leaders will bring good results in getting all the boys interested in worthwhile affairs. Such affairs are largely a matter of the environment and local surroundings, but music, athletics and books are always things toward which to guide a boy's thoughts. Appreciation of the interest shown is quick to come in many cases and leadership is thus made easier. The outstanding boy is mentioned and the emphasis should be placed on such boy or boys. By taking one boy, cultivating his talents and abilities, and making a noticeable change in his actions and expressions, there will be a tendency among the rest to try to excel in order that they may be chosen to be so advertised later on, for all are quick to see the value of public appearance, some special privileges, or even a speaking relationship with officials.

Most boys have dreams as to their futures, and often times these dreams are very tenderly cared for and are kept away from the sight of interested eyes, especially the eyes of parents. The apprentice instructor is often the one who will be allowed to behold this dream, and if the boy feels his sacred ideas are receiving due respect, he will open out and tell his dreams and ambitions to the instructor in such a way that much help can be given him to attain these ends. This characteristic is one that must be studied and the boy's point of view must be used when it is studied. Too many plans have received a laugh be-

cause the one hearing them had no sympathy, no understanding of a boy, and no realization that the far flung goal of a boy's ambition has been reached many a time in far less years than even that boy had planned. Sympathetic analysis of a boy's desires and his natural ability will do much toward guiding him to the place where he can make the most of himself and his life. Many irresponsible troublemakers will, if guided aright, be changed into earnest, industrious workers. A complete personal survey to determine each boy's desires and capabilities will be well worth the time it takes.

This survey and study logically become the first steps in vocational guidance, which should be carried out as far as time and facilities permit. It is here that close cooperation with the employment department will help solve many problems. To be able to turn to the apprentice school and find men who have expressed themselves desirous of working on certain jobs and have studied such jobs, will assist the employment department in giving the best service. On the other hand, the instructor should be able to place certain men with outstanding characteristics in the places for which they are best fitted by consulting the employment department as to vacancies, etc. The right man in the right job is a big factor in the success of every organization, and it is worth time and study to accomplish this even in a small way. In his relations with the apprentices, the instructor must correct from the very start the tendency to take the opportunities offered in the apprentice school for granted, and he must inspire the boys to do their utmost so that they may receive the fullest benefit from their work.

### Looking through the boys' eyes

It is only correct to assume that the supervisor must have a close knowledge of the industrial problems confronting the apprentices. He should know their working conditions, their living expenses, the probable irritating points in their work and must see all these through the boys' eyes as nearly as possible. The variation in dispositions of foremen and fellow workmen should be studied, and the boy should be taught to consider this matter in his dealings with foremen and others throughout his career. The importance of the relation between wages and expenses during the low pay periods should be thought of, and every effort should be made to encourage boys supporting themselves to win through this time, until they reach more or less financial independence through the natural increases in their pay.

The apprentice supervisor must be fair and just in all his dealings and must see that the company also keeps faith in its relations with the apprentices. It must never be forgotten that these boys are in a state of flux and impressions made at this time will leave an indelible mark. So, the supervisor must himself be fair and just, he must see that the foremen treat the apprentices properly and he must not make any statements to the apprentices that he is not certain that the company will carry out, through his knowledge of its policies. If boys are promised changes in work, no matter how rushed or overworked an instructor may be this promise must be fulfilled; if a threat to discharge is made for repetition of a certain offense, this must be carried out, and thus will be built a system, founded on the boy's faith in this system through his own knowledge that he is receiving a fair deal, that he is a member of an organization that has a definite purpose and is seeing that this purpose is carried out in all fairness and at all costs.

### Contacts with officials

It is a stimulus to work, especially among young men, if the superintendent or higher officials make occasional visits to the schoolroom and perhaps, say a few words. The feeling engendered is valuable and is sure to increase the boys' interest in their school work. These little contacts are thought about and spoken of by all boys, for acquaintance with supervisors always appeals strongly to a boy. Much good is done, also, for boys are quick to defend those who are showing an interest in their welfare.

One of the best ways to find out how much an apprentice has learned during his course, how much initiative he has and what responsibilities he is willing to assume, is to bring him to the apprentice instructor's office for at least one month's work during the last two or three months of his apprenticeship. Usually there are many sketching jobs to be done, and by sending the apprentice out to do this work and letting him take the responsibility of procuring all the necessary information for the completion of the sketch, even to making a tracing and blueprint, he will quickly show his training and capacity for handling bigger jobs. If mistakes are made and corrected during this period, the background of his previous training will take on a new value, and he will perceive the use of many things he has learned. Such a period, in close every-day contact with the apprentice instructor, gives him confidence in his training and the knowledge that the tools he has learned to use are good tools that can be depended upon. At this time, the apprentice obtains a view of the shop organization as a whole and learns the interdependence of the various departments. The problems of supervision, also, come to his attention and he sees, perhaps for the first time, the many interesting problems which lie ahead of him. Here he is given a taste of responsibility and can also see the responsibilities that have to be assumed by others.

The multitudinous phases of any work with growing boys are too difficult to cover completely in a short discussion of this great subject. For that reason, the foregoing paragraphs are intended, merely, as an outline of one of the sides of apprentice work which has not, perhaps, received the consideration and study which is due it. That these ideas are of real practical value is being proven daily in the apprentice school of the Lehigh Valley system shops at Sayre, Pa. The returns to an organization from moral training may easily be worth many times the value such an organization might receive from technical or trade education alone. To properly combine the two is, of course, ideal, and like all ideals, much investigation and study must be given the methods to attain it.

**Indicating and recording apparatus of the locomotive testing plant at Purdue University**

# Texas & Pacific eight-wheel switchers

*Tractive force of 54,000 lb.—Application of tender boosters to two locomotives gives an additional tractive force of 15,000 lb.*

A NOTABLE feature of locomotive development during recent years has been the improvement in the design of switching locomotives, with a view of increasing their capacity and efficiency. The present-day heavy switcher is often specially designed for the work to be done, and is equipped with much the same road locomotives operate. They are called upon for helper service out of the Marshall, Tex., and Baird yards where it is necessary to help full tonnage trains over grades from two to four miles in length. Some of the new engines have also been assigned to transfer service in the Fort Worth, Tex., and Shreveport, La., terminals.

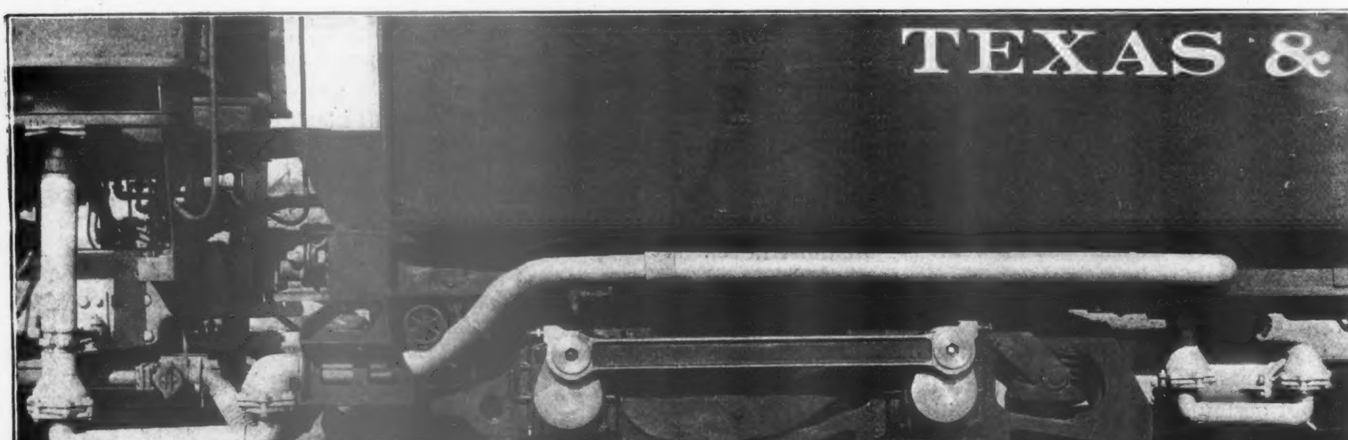

Texas & Pacific eight-wheel switcher with Franklin tender booster

fuel and labor-saving devices which have been used with conspicuous success in high-powered locomotives for road service.

Among the outstanding switching locomotives which have thus far been built are ten recently completed by the Baldwin Locomotive Works for the Texas & Pacific. The locomotives have the 0-8-0 wheel arrangement and, although not the heaviest of their type, are designed to develop maximum power output within the weight limitations imposed. They are built to operate on curves as sharp as 22 deg. and grades up to three per cent and develop a rated tractive force of 54,500 lb.

These locomotives are designed to handle the heavy yard work in the terminals out of which the road's heaviest

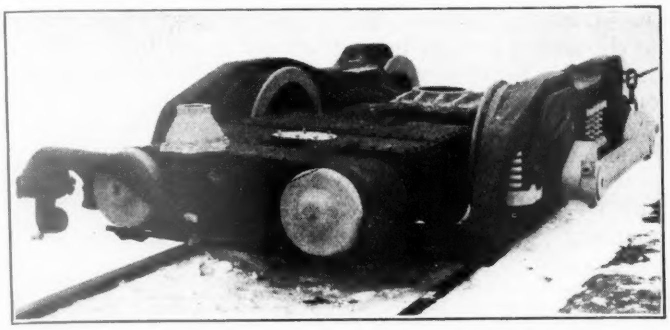
Two of the locomotives are equipped with boosters applied to the forward tender trucks, giving these engines a total maximum tractive force of 69,500 lb. in forward motion. This additional tractive force is provided to handle at one pull 800 tons on and off a transfer boat operating across the Mississippi River at New Orleans, La., up inclines with grades of about four per cent. With present switching power it is necessary to make two or three trips on and off the boat when it is loaded to capacity which materially delays the movement of traffic across the river. One of the locomotives is assigned to service on each side of the river.




The steam pipe connections to the booster

An important feature of these locomotives is the limited maximum cut-off with starting ports. The Pennsylvania

has used this construction for a number of years in heavy road engines and more recently has incorporated it in the design of eight-wheel switchers. It has also been applied to road engines for the Texas & Pacific and other roads. In the Texas & Pacific switchers the cut-off is limited to 65 per cent of the stroke. As locomotives of this type operate a longer part of the time in full gear cut-off, it is evident that limiting the maximum cut-off must result in a very high economy in the use of fuel and water. The starting ports, which are an essential feature of the limited



A rear view of the booster truck, showing the engine in place

cut-off, provide means for readily and quickly starting the locomotive in either direction. Compensating ports are also provided in the head end of the valve bushing. The function of these ports is to lengthen slightly the cut-off on the head end of the cylinder, thereby increasing the tractive force without a corresponding decrease in the minimum factor of adhesion. Plugs are provided in the side of the steam chest opposite the starting ports for cleaning purposes.

The valves are set with a maximum travel of 8¾ in., the steam lap is 2½ in., the exhaust lap is ⅛ in., and the lead is ⅛ in., and the steam distribution is controlled by the valve motion of the Baker type, controlled by a power reverse mechanism.

The cylinders are of cast steel with outside exhaust passages, each cylinder being made in one piece, with a half saddle. The cylinder barrels are bushed with gun iron. Effective lubrication at all times is assured by the use of both a hydrostatic and a mechanical lubricator.

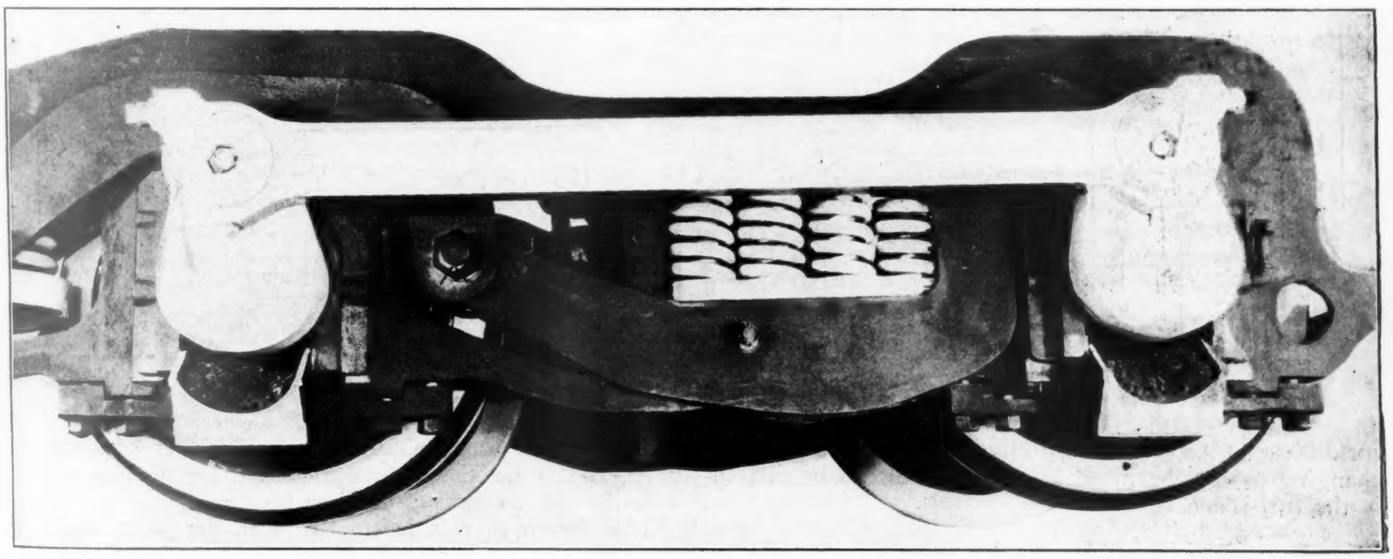
Machinery details include piston heads of rolled steel, with gun iron bull rings; piston rods of normalized carbon vanadium steel; and crank pins and valve gear forgings, with the exception of the eccentric rods, of the same material. The main crank pins are hollow bored. The crossheads are of the alligator type, with chrome-vanadium steel keys; and the guides and guide yoke are of most substantial construction, designed for severe service.

The main rods are of the articulated type, distributing the load between the crank pins of the third and fourth pairs of driving wheels. Floating bronze bushings are used on the intermediate side rod connections. The main and side rods are of normalized carbon vanadium steel. Heat treated steel is used for the driving axles, which are hollow bored. The play between rails and flanges is 13/16 in. on the front and back drivers, and 9/16 in. on the intermediate and main pairs.

The frames are 5 in. wide, and special attention has been given the transverse bracing in order to insure ample strength and preserve alinement in severe service. Fillets of liberal radius are used throughout, and each frame is cast in one piece with a single front rail of heavy section. The pedestal wedges are of the self-adjusting type.

The boiler has a straight top and carries a working pressure of 250 lb. At present the locomotives are equipped for burning oil, but they are so designed that they can be readily modified to burn coal if desired. The Booth burner is applied, and the equipment is arranged in accordance with the railroad's standards. The firebox contains two thermic syphons.

Liberal use is made of flexible bolts in the staying of the firebox. There is a complete installation in the throat and about 67 per cent of the bolts in the side and water legs are of the flexible type. Flexible bolts are used in the two outside rows and upper corners of the backhead and flexible crown bolts are placed in the three transverse rows at the front of the firebox and in the three outside rows on each side of the top center line.



The equalizers are arranged to support the cylinder overhang at the left

The throttle valve is placed in the smokebox and is connected with the dome by an internal dry pipe having a shut-off valve at its rear end. With this arrangement, the superheater is filled with steam at all times, and superheated steam can be used for the auxiliaries. The Type A superheater has 34 elements.

The boiler accessories include two steam turrets, one for saturated and one for superheated steam, which are both placed in front of the cab. All the valves have extension handles, properly labeled and conveniently located for the engine crew. The saturated steam turret

has connections for the injectors, fire extinguishers, cab steam heat, squirt hose, and power reverse, while the superheated steam turret supplies the air pump, blower, the headlight turbine, and all oil-burning steam connections. This turret is supplied by an outside steam pipe, placed on the left side of the boiler and properly designed to allow for expansion.

The fire extinguisher, to which reference has been made, has two water inlets, one connected to the tank and the other for coupling to a fire plug. The locomotive carries 50 ft. of 2-in. fire hose.

The cab is steam heated, equipped with Lima seats and with a clothes locker for the crew. The tools are carried in a combination tool and sand box placed in the front of the tender tank. The running boards are straight and are placed as low down as possible. This, in combination with a long, low tank, gives the engineman a clear view in both directions.

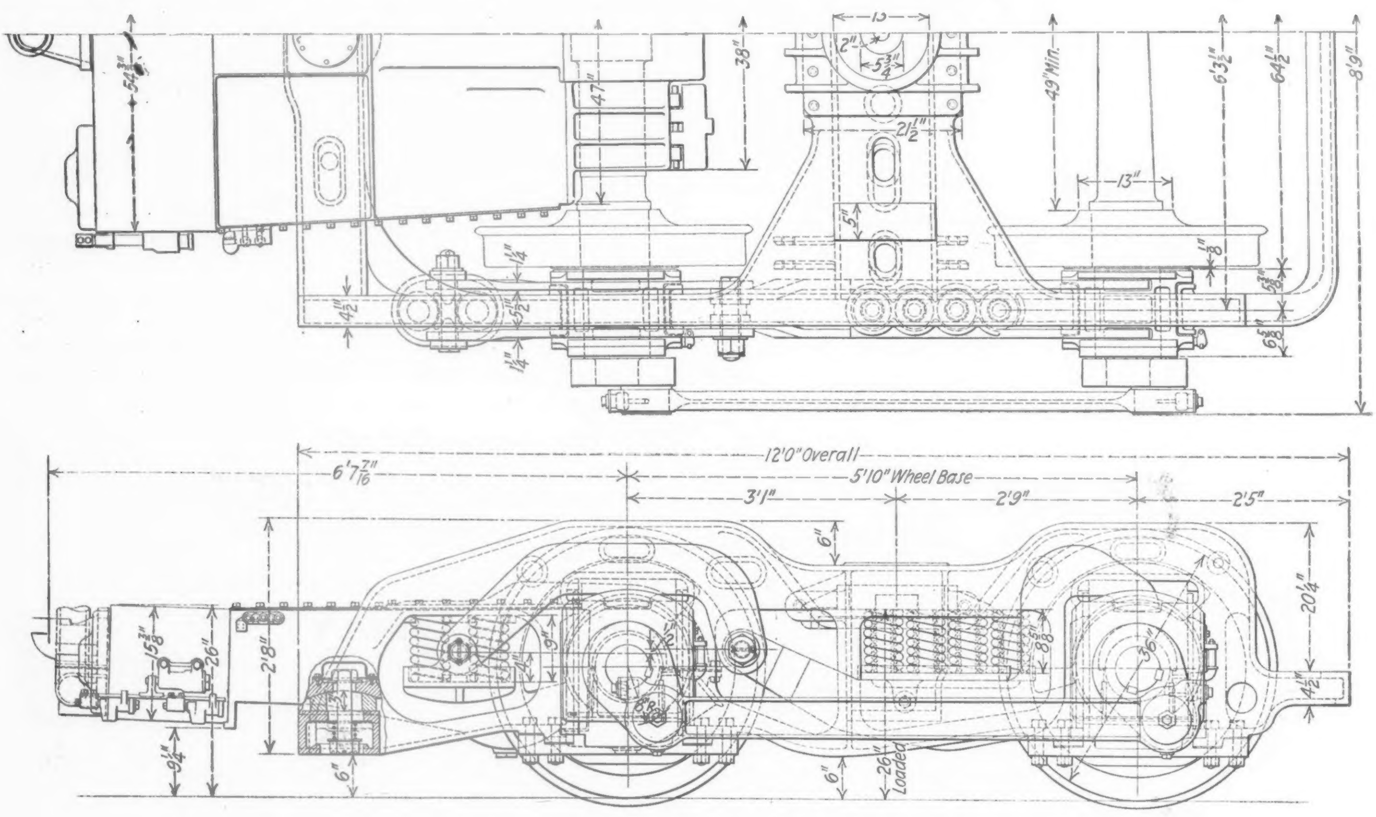
The tender has a Commonwealth cast steel frame made in one piece. The oil and water tanks have capacities

The arrangement of the booster engine on the truck provides great accessibility for any attention that it may need.

The truck is fitted with 36-in. wheels and the journals measure 9 in. by 12 in. They have ordinary surface bearings lubricated in the standard manner as is customary with tender trucks, and one of the illustrations shows the ease with which the cellars may be removed for repacking. The side rods are made of carbon-vanadium steel.

The booster is piped to take superheated steam under the control of the main engine throttle, supplemented by the regular automatic booster control. The booster exhaust is arranged so that it can be discharged either into the atmosphere or into the tender water tank. Thus, it is possible to recover the heat units in the exhaust steam from the booster.

With the use of the booster, the maximum tractive force of the locomotive alone, amounting to 54,500 lb., can be increased by 15,000 lb. This fits these locomotives especially for hump yard service, or for work where inclines are encountered and exceptionally high tractive force must




Assembly drawing of the Franklin tender booster

for 3,000 and 9,500 gal., respectively, and, in the event of changing to coal burning, 12 tons of coal can be carried in the fuel space.

## The Franklin tender booster

As has been mentioned, the tenders of two of these locomotives are equipped with boosters furnished by the Franklin Railway Supply Company. The booster is mounted on the front truck, which is of unique design. The frames are made in one solid cast steel piece, with a cross transom at the rear end to support the booster engine, similar to the familiar support of the booster on locomotive trailing trucks. A unique feature regarding the equalizing of this truck is, that it is arranged so that a greater proportion of the load comes on the wheel that is directly driven by the booster, thereby relieving the side rods of all unnecessary strain. The truck frame construction and equalizer system are shown in the illustrations.

be exerted for short periods of time. Under such conditions, the boiler power is sufficient to furnish steam to both the main cylinders and the booster.

The design of this locomotive was the joint work of the railway's motive power department and the builders and was supervised by A. P. Prendergast, mechanical superintendent of the Texas & Pacific. The cab fittings were located under the personal supervision of R. W. Salisbury, mechanical engineer of the railroad, and the resulting arrangement is exceedingly convenient. The accompanying table of dimensions and proportions gives further particulars concerning these locomotives.

**Table of dimensions, weights and proportions of the Texas & Pacific 0-8-0 type of locomotive**

| | |
|---|---|
| Builder | Baldwin |
| Type of locomotive | 0-8-0 |
| Service | Switching |
| Cylinders, diameter and stroke | 22 in. by 28 in. |
| Valve gear, type | Baker |
| Valves, piston type, size | 12 in. |

| | |
|---|---|
| Maximum travel | 8¾ in. |
| Outside lap | 2½ in. |
| Exhaust clearance | ⅛ in. |
| Lead in full gear | ⅛ in. |
| Cut-off in full gear, per cent | 65 |
| **Weights in working order:** | |
| On drivers | 230,870 lb. |
| Total engine | 230,870 lb. |
| Tender | 197,130 lb. |
| **Wheel bases:** | |
| Driving | 15 ft. |
| Total engine | 15 ft. |
| Total engine and tender | 55 ft. 4½ in. |
| **Wheels, diameter outside tires:** | |
| Driving | 51 in. |
| **Journals, diameter and length:** | |
| Driving, main | 11 in. by 12 in. |
| Driving, others | 10 in. by 12 in. |
| **Boiler:** | |
| Type | Straight top |
| Steam pressure | 250 lb. |
| Fuel | Oil |
| Diameter, first ring, inside | 78 in. |
| Firebox, length and width | 102 1/16 in. by 75¼ in |
| Tubes, number and diameter | 199—2 in. |
| Flues, number and diameter | 34—5 in. |
| Length over tube sheets | 15 ft. |
| Grate area | 53.4 sq. ft. |
| **Heating surfaces:** | |
| Firebox | 176 sq. ft. |
| Thermic syphons | 55 sq. ft. |
| Tubes and flues | 2,284 sq. ft. |
| Total evaporative | 2,515 sq. ft. |
| Superheating | 574 sq. ft. |
| Combined heating surface | 3,089 sq. ft. |
| **Tender:** | |
| Style | Water leg |
| Water capacity | 9,500 gal. |
| Fuel capacity | 3,000 gal. |
| Journals, diameter and length, front | 9 in. by 12 in. |
| Journals, diameter and length, back | 6 in. by 11 in. |
| **General data estimated:** | |
| Tractive force | 54,500 lb. |
| Tractive force, tender booster | 15,000 lb. |
| Total tractive force, locomotive and booster | 69,500 lb. |
| **Weight proportions:** | |
| Weight on drivers ÷ tractive force | 4.28 |
| Total weight engine ÷ comb. heat. surface | 91.6 |
| **Boiler proportions:** | |
| Tractive force ÷ comb. heat surface | 17.6 |
| Tractive force × diam. drivers ÷ comb. heating surface | 9.00 |
| Firebox heat. surface ÷ grate area | 3.3 |
| Firebox heat. surface, per cent of evap. heating surface | 7.02 |
| Superheat. surface, per cent of evap. heating surface | 22.8 |

# The foreman's responsibilities*

## Leaks of all kinds must be stopped—Relations with employees and with the public

*By Frank J. Borer*

*Freight shop foreman, Central Railroad of New Jersey, Elizabethport, N. J.*

"THE locomotive is only as good as its boiler," fittingly reads the heading of an advertisement on the front page of the magazine. It would be appropriate to say the "the foreman is only as good as the education and training he has received."

The opportunities of the foreman are many and to grasp or seize them he must train himself and never cease to grow in knowledge. Moreover, knowledge is of no value unless properly applied. Fine sentiments without action to back them up gets one nowhere. The foreman is measured by final results—production, quality and quantity of work done and cost at which produced.

Each foreman, whether he supervises six or six hundred men singly or jointly with other foremen, should be properly charged with any inefficiency, irregularities or low morale of the men and consider this a liability on his "balance sheet." He should be just as much interested in clearing off this "debt" as in paying his annual tax bill.

### Leaks of all kinds

Who is this foreman about whom there has been so much said in recent years? Let us put him under the searchlight for a moment and analyze him. Are there any leaks in his department, and if there are, has he used all the means at his disposal to stop them? How about steam, water, gas, light and power leaks? How about coal, oil, waste and all kinds of material leaks? How about time leaks? Men not starting promptly on time or washing up before the whistle blows? Did you ever figure the loss on account of this last item alone? As an example, let each man in a railroad shop employing 1,000 men quit work ten minutes before the whistle blows at night, and figure the wages paid just at 50c an hour. At this rate of pay, the loss to the railroad, per year of 300 working days, would be $25 per man, or $25,000 for 1,000 men—enough money to purchase about 10 new freight cars.

There is a possibility of a "leak" by machines not working to capacity. Men waiting for material or having to walk too far for material or tools are other items needing careful watching by foremen. Then there is the fellow who wants to enjoy a quiet smoke at some secluded spot every morning and every afternoon for a half-hour or so until the foreman "discovers" the "leak." Don't tell me there are none of them in your shop, for there are several of them in every shop, or maybe you have his prototype in the form of the fellow who always has to tell everybody how much work he has to do, and loses so much time on this account that he is really always behind unless checked up.

There are other numerous "leaks" ready to develop, such as wrong material, or not enough or too much material furnished to the men. Surplus material laying around gets spoiled, or finds its way to the scrap heap. Material may be incorrectly laid out. Then there is poor workmanship due to wrong or insufficient instructions, or wrong assignment of men—scrap laying in passageways has been an indirect cause of many accidents—heating furnaces or rivet heating forges in full blast before forgings or rivets are nearly ready to be placed in them—allowing mechanics to stroll around the shop looking for material when this should have been attended to by helper or laborer.

These are all sins chargeable to the foreman, if they exist, and they surely are leaks in the treasury of the railroad.

### Constructive suggestions

The opportunities of the foremen lay in making constructive suggestions and recommendations as to labor saving devices, or short-cut methods to greater economy in the use of power and shop facilities in general; improving and standardizing car and locomotive parts; find-

*Submitted in the Railway Mechanical Engineer competition on the foremen's responsibilities and opportunities.

ing the best ways and means of using obsolete material for other purposes; reclamation and preservation of lumber; reclaiming various parts for locomotives and cars by means of welding and cutting or other means; proper selection, preparation, use and care of tools and devices, grinding wheels, jigs, gages and templets; suggestions for overcoming car and engine failures.

Prevention of accidents is another field where the foreman can find much that needs his continued attention.

The locomotive department foreman has many exacting responsibilities if the finished locomotive is to be as nearly as possible 100 per cent efficient when released for service. By careful supervision he can often correct a defect that would reduce the locomotive mileage between shoppings thousands of miles if the defect had not been discovered.

The car department foreman must keep himself and those under his supervision posted in regard to the A.R.A. rules of interchange and loading rules. Much money may be lost by a railroad through wrong interpretation or ignorance of the rules on the part of its foremen. Incorrect or insufficient billing information, incorrect defect carding for improper or wrong repairs, receiving of cars in interchange not in compliance with the rules, careless inspection of cars before loading, will cost the railroad large sums of money. Such "leaks" are often hard to discover.

Then there is his job of chief inspector of his department or sub-department. Does he correct mistakes made by his men? If not, he is not making good. Take a truck archbar for illustration. Someone laid it out inaccurately. It measures 3/16 in. more between wheelbase centers than it should. If applied it will cause excessive wheel flange wear from the start, necessitating removal of the wheel in perhaps six months instead of six years. Would it not be much better to either upset the archbar to the correct length or to scrap it?

### Attitude toward employees

But the foreman has other responsibilities and opportunities. There is the apprentice that needs a word of encouragement, instructions and advice to create an incentive for efficiency and economy. The laborer is not always given the consideration he deserves in instructing him in assorting and handling material and in making his job more attractive, not by giving him mechanic's wages or by painting his shovel or broom handle a golden yellow, but by simple human kindness, by a full realization that his services are just as essential as those of the mechanic, by teaching him the a. b. c. of saving usable parts from scrap, by making him take a deeper interest in keeping the shop clean, aisles between cars and locomotives and around fire hydrants clear of obstructions and by removing fire hazards around the property on his own volition.

Putting the searchlight on our foreman from another angle, we find that if he is to be a successful supervisor, he must be impartial, have sobriety in temperament, and not fritter his idle hours away in excesses of any kind. His department will gain or lose in strength, and in efficiency exactly to the extent that he is able to properly carry out the policy and orders of the higher officials. It all depends on how much effort he puts forth to overcome the difficulties and complexities of daily contact with the men and the management. To lighten the burden of responsibilities, it is well for the foreman to be diplomatic and conciliatory. He should make it a particular point to be easily approachable, and seek and welcome constructive criticism and suggestions and contact with the men, and use his authority to discipline or dismiss employees with the utmost care and justice, without passion.

"Don't be over ambitious if you want to be successful," advises Otto Kahn, the well-known American banker. In a recent message to young business men, he set forth in part the following as principles for success: "It is important to perform minor, as well as major, tasks to the best of one's ability. Free yourself of skepticism, mistrust and suspicion. Be ready to be fully prepared, but be patient, bide your time, know how to wait. By all means keep a sharp outlook for opportunities, recognize them and seize them boldly when they come within your reach. But do not think that every change means an opportunity. Stick-to-it-ness of perseverance, of courage to carry on in the face of hope deferred and plans thwarted. Don't think that you can lift yourself by downing others. Throw overboard envy and ill-will. They corrode the things they touch." Young ambitious foremen and inspectors in particular may well profit by following this advice.

### Public relations

When out of the shop, the foremen's opportunities are many of taking part in debating public questions and helping to mold public opinion. It is here that he can become the "go-between" the railroad and the general public and enlighten his fellowmen about the many complex problems in regard to transportation.

The work of the foreman who has his company's interest really at heart is never finished. This does not mean that he should neglect his home or private affairs. But, as we are all inter-dependent, and as the foreman plays an indirect part in every branch of transportation, his task cannot end when he leaves the shop. He can help to secure a closer co-operation between railroads and shippers.

The question of government versus private ownership of railroads has at least temporarily been settled by an overwhelming defeat at the last election. Yet it may come up again and every mechanical department foreman should consider it his opportunity to uphold that which by test has proven to be best. Yet as every day of our life is a test day—as each page of a book is a co-related part of the whole—so must the every-day performances of transportation service be a stamp of approval for the continued perpetuation of that service. The foreman can do a great deal to make that service better and better, and to bring about a closer understanding, a unity of purpose and complete co-operation between the owners of the American railroads, the shippers and the general public.

Next to the Bible, the constitution of the United States is still the most important document in existence for us today, and every foreman worthy of the name will consider it a privilege to uphold it.

Don't be a quitter
Whatever you do.
Stand up and fight
'Til you are filled through and through.
With a confidence born
Of a conquering mind,
Let no lack of courage put you behind.
For great men have plodded their rocky trail,
Heeding not that little word called fail.
'Twas onward and onward,
Day after day,
Till they reached success,
The right highway.


# N. P. buys ten observation-club cars

### Designers have provided unusually complete toilet and lounging facilities—Length over end sills of 77 ft. 3 in.

On April 1, 1926, 10 steel observation-club cars were placed in service by the Northern Pacific on its North Coast Limited trains running between Chicago and Seattle, Wash. These cars were built by the Pullman Car & Manufacturing Company and the first of the cars to be delivered was taken on a month's tour, under the supervision of representatives of the passenger-traffic department of the Northern Pacific, which included 47 eastern and middle western cities. This tour was completed on the return of the car to Chicago on March 20, 1926.

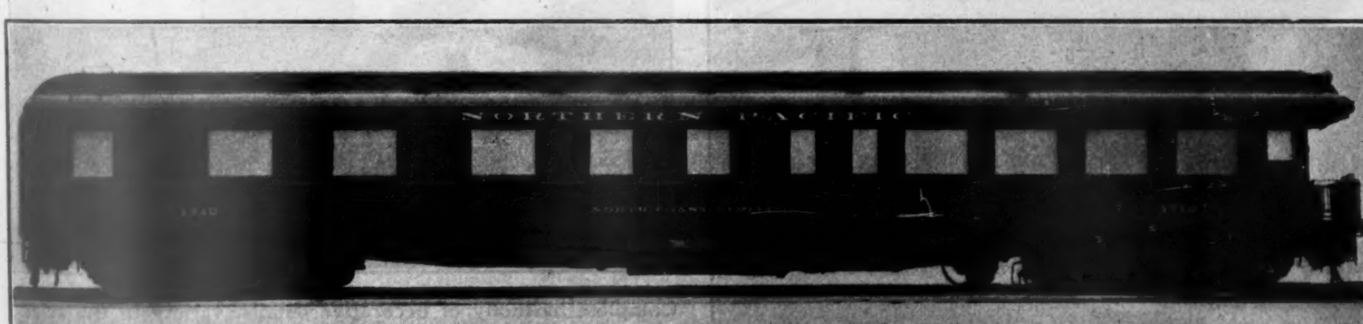
A number of unusual features have been incorporated in the design of these cars. As shown in the floor plan arrangement, the car contains a large observation room, buffet barber shop, a men's toilet, two men's smoking rooms and a women's lounging room. Shower baths are provided for both the men and women.

In order to provide room for these unusually complete toilet and club lounging facilities in a single car, these cars have been built with an overall length of 83 ft. and complete utilization of the possibilities of this length has been effected by building the cars without front vestibules, entrance being gained through the adjoining Pullman cars. Another unusual feature is the elimination of passenger steps and trap doors from the observation platform at the rear of the car in order that there be no interference with the complete use of the observation platform at all times by the passengers on the train.

#### Interior arrangement and equipment

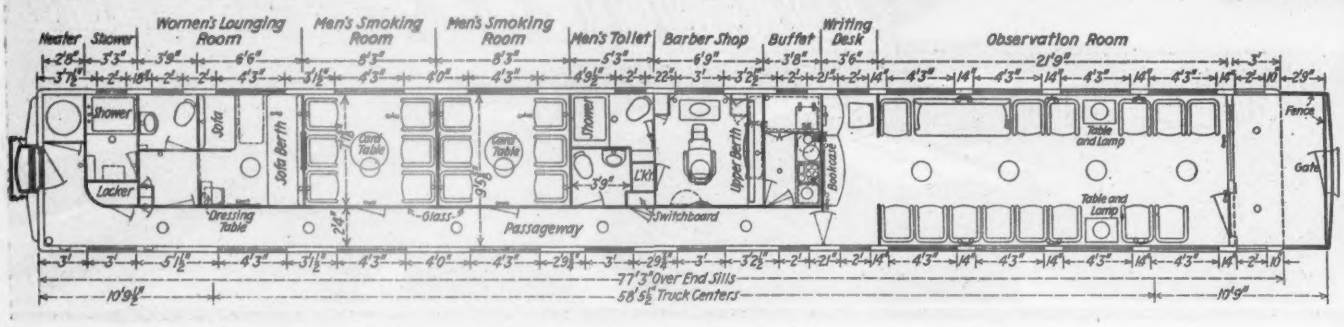
How the floor space of the car has been utilized is clearly indicated in the floor plan drawing, from which it will be seen that, starting at the forward end of the car, behind the Baker heater compartment, are the ladies' rooms, a single entrance from the corridor communicating with complete shower bath and toilet facilities and a lounging room, the long sofa in which may be made up into a sofa berth. Mirrors are provided in the wall over the lounge sofa and over the dressing table and a full length mirror is placed in the wall between the lounging room and the corridor.

Adjoining the women's rooms are two men's smoking rooms, each equipped with six leather upholstered chairs and a card table. An attractive feature of these rooms is found in the glass panels in the corridor partition on both sides of the doorway into each of these rooms which




**The windows of the new Northern Pacific observation-club cars for the North Coast Limited are unusually large—The window at the rear end of the observation room is 4 ft. 2 in. high and 5 ft. wide**

enable the occupants to see out of both sides of the car. Adjoining the second smoking room is the men's toilet, accessible from the corridor, and next is a well-appointed barber shop, through which access is had to the men's shower bath. Behind the large mirror in the side of the barber shop opposite the shower bath is an upper berth for the use of the attendant. The barber shop and shower are finished in white enamel and the barber shop is completely and conveniently equipped with all necessary fixtures, including a white porcelain pedestal washstand and a full size barber chair. The buffet, which occupies the last compartment adjoining the observation room, is equipped with the essential apparatus for dispensing soda water drinks and other cold beverages and is well supplied with refrigerator and locker space.




The floor arrangement of the Northern Pacific observation-club car

In the observation room which is slightly over 25 ft. in length, there is a marked departure from the conventional type and arrangement of furniture. It will be seen that on either side of the car has been placed a small table and reading lamp and that on one side is a capacious sofa. Across the car from the sofa is a Victor orthophonic phonograph in a cabinet which harmonized in style and finish with the other furnishings and decorations.

The observation platform is without trap doors, stirrup steps being provided for the trainmen—The searchlight over the hood is for the pleasure of the passengers

The comfort and general attractiveness of this room is further enhanced by the use of chairs of three distinct types each differing from the others in appearance so markedly that the monotony of the customary rows of chairs in observation and club cars is completely eliminated. The possibility of finding a comfortable seat has also been increased by slight variations in height or tilt of those chairs which otherwise are identical in appearance.

From an inspection of the car, it at once becomes evi-

Complete harmony of decorative details, variety in the selection of furniture and the use of table reading lamps give character to this observation room

dent that its interior decoration and furnishing was not left to the engineering designer. As the keynote of the decoration of the observation room, the men's smoking rooms and the women's lounging room, the Adam motif was selected and this has been applied to produce a charming effect of harmony and good taste. The interior is finished in French walnut decorated with a color scheme in decalcomania which harmonizes with the soft colors of the carpet specially woven to conform in figure with the prevailing scheme of decoration. The floor consists of a composition top surface laid on a wood base.

The lighting fixtures were designed and manufactured especially for these cars with ornamentation and coloring in harmony with the Adam motif. The finish on the metal portions of the lighting fixtures is stained brass, accen-

tuated with delicate light colors, including jade, new blue and ox-blood. In addition to ceiling lights and bracket fixtures suitably located throughout the car, the use of well-proportioned table lamps adds materially to the home-like appearance of the observation room. These table-lamps weigh about 60 lb. each and are said to have demonstrated their stability even under severe switching impacts. The car is constructed with a square-decked ceiling finished in ivory-colored agasote, decorated with decalcomania and pencil stripes. Ornate bronze grilles conceal the heating pipes and add a decorative touch to the lower walls.

### The windows are of unusually large size

The windows are unusually large, both in height and width, and a person of ordinary height can readily see out of the car while standing erect. The window at the rear end of the observation room is said to be the largest ever used in car construction, measuring 4 ft. 2 in. in height by 5 ft. in width. The windows throughout are of double sash construction and in winter time a third sash is applied to the outside of the car. The shades are of silk-faced pantasote, colored to harmonize with the general scheme.

A floodlighting unit, containing a 250-watt projection type lamp, is mounted on the roof at the rear of the car. Its elevation and direction are controlled by a lever and hand wheel from the observation platform so that passengers can use it at night to view the passing scenery.

These cars, which are 83 ft. in overall length, measure 77 ft. 3 in. over the end sills and weigh 170,500 lb. The trucks, which are spaced 58 ft. 5½ in. between centers, are cast steel of the six-wheel, top equalized type. They are equipped with the Miner safety locking device, Stucki side bearings and Simplex clasp brakes.

### The electrical equipment

Five of the 10 cars are equipped with Putnam, 16-cell storage batteries, type CLEF-25 which have a capacity of 360 amp. hrs. The other five cars are equipped with 16 Exide storage batteries, type EP-15, having a capacity of 350 amp. hrs. The axle generators were furnished by the Safety Car Heating & Lighting Company and have a capacity of 4 kw. at 40 volts. They are mounted at the center line of the car and are driven by a 5-in. belt from barrel type axle pulleys. The generator regulators are of the standard Safety type as applied on the general service cars of the Pullman Company. The lamp regulators are the Safety type F of 50-ampere capacity.

These cars are also equipped with the Western Electric Company's desk type telephones which can be brought out of the locker when required and plugged into a jack located at the desk in the observation room. Under the desk is a set box which is wired to a receptacle located over the observation platform to which connection is made at important cities along the line which provides the passenger's telephone service while the train is waiting at these points.

The cars are fitted with the Miner friction draft gear and buffing device, and the Pullman coupler centering and carrying device. Other special equipment of the cars includes Utility ventilators on five of the cars and Mudge ventilators on the other five, with exhaust fan ventilators in the ladies' room and the two men's smoking rooms. The brakes are of the Westinghouse U.C. type with two 14-in. cylinders.

# Some fundamentals of the air brake*

## A discussion of the braking problems of modern freight and passenger train operation

By *Joseph C. McCune*

*Assistant director of engineering, Westinghouse Air Brake Company, Wilmerding, Pa.*

FROM a retardation viewpoint, the most important aspect of the brake rigging is its efficiency in multiplying and transmitting the brake cylinder force to the brake shoes. The losses in the foundation brake rigging are of two descriptions; first, frictional losses and, second, losses due to the angularity between the levers. The frictional losses arise not only at the various pins, but also in connection with the guides and will be as a rule increased with the number of parts of the foundation brake rigging. Since the movable parts of the foundation brake rigging on a modern passenger car weigh approximately two tons, it will be seen that the frictional losses may reach a considerable magnitude with a well designed rigging, the losses due to the angularity of the levers should be small. To bring about appreciable losses from this source, the levers must attain very awkward angles in order that the components acting at right angles will be sensibly diminished from the forces going along the lines of action of the levers themselves.

### Foundation brake rigging design

Numerous brake riggings have been constructed, however, which overlook the conditions brought about when shoes and wheels are worn and when brake adjustment has been neglected. Such conditions must be given more careful consideration when the brake rigging is of the single shoe type because with modern brake shoe pressures, single shoes must be located a considerable distance below the wheel center which permits them to travel along the wheel periphery during a brake application and cause more movement of the various levers than may have been contemplated in the design.

To overcome such a condition with others which need not be enumerated here clasp brakes or a rigging which calls for two brake shoes per wheel, has been applied quite generally to modern passenger equipment cars and indeed to an increasing number of locomotive tenders.

The losses in the foundation brake rigging are not well known and actually for running conditions can scarcely be given any quantitative values. The writer knows of only two attempts to measure the mechanical efficiency of foundation brake rigging; one made about 1894 by the late W. H. Marshall, a former president of the American Locomotive Company and, second, during the Pennsylvania-Westinghouse brake tests, above mentioned. Mr. Marshall found that in an emergency application of freight car brakes, only 77 per cent of the calculated pull

* Abstract of paper read before the Eastern New York Section of the American Society of Mechanical Engineers, Schenectady, N. Y., Nov. 20, 1925.

upon each brake beam was actually realized. Some standing experiments were made during the Pennsylvania-Westinghouse tests by means of a hardened ball bearing upon a steel plate. From these experiments it was found that the force transmitted was from 60 per cent to 85 per cent of the force calculated from the pressure acting upon the brake cylinder piston. It has been generally considered that when trains are running the efficiency of the brake rigging is greater than when the train is standing, the vibration causing the members of the brake rigging to move with the development of less friction.

It should be evident, however, that a proper foundation brake rigging is essential if the best braking performance is to be secured. Not only must the brake rigging be of such design that it transmits the brake cylinder force with a minimum loss, but also other factors must be considered if the rigging is not to cause conditions which lower the efficiency of the air brake proper. The foundation brake rigging should be of such construction as to keep the piston travel in the brake cylinder as nearly constant as practicable under all conditions of shoe and wheel wear, etc. Also the brake rigging should distribute the brake cylinder force uniformly, in proportion to the weight braked, to all wheels. A good foundation brake rigging should be designed with such requirements in mind as precaution against accidents due to parts dropping on the track, obtaining minimum brake shoe wear, minimum expense of maintenance, maximum ease of adjustment and provision against improper interchange of parts, etc.

The efficiency of the foundation brake rigging may be controlled to a degree by a satisfactory design. Brake shoe friction on the other hand, can scarcely be controlled although it is obvious that the shoes employed should be of a material which will afford the best coefficient of friction.

### Coefficient of friction varies in service

In service, the coefficient of friction varies over a wide range. Exact data as to the variation of the coefficient of friction under service conditions are by no means as extensive as they should be if the coefficient of friction is to be determined for all the varied conditions that may arise in service. Experimental investigations indicate, however, that the coefficient of friction varies with the pressure, the velocity and the time the brake shoe has been rubbing against the car wheel. The exact variation of the coefficient of friction with pressure is not known but all indications point to a reduction in the coefficient of friction as the pressure is increased. Such a relationship would be contrary to the results found in early experiments when slow moving bodies were considered. It should be mentioned that the action at high velocities is quite different from that existing at very low velocities.

The coefficient of friction decreases with the velocity. The curve showing the relation of velocity to the coefficient of friction appears to be a rectangular hyperbola. Having such a curve in mind, it will be readily appreciated that as the velocity reduces the coefficient of friction approaches a constant value and more and more slowly as zero velocity is reached. On the other hand, as the velocity increases, the coefficient of friction approaches some value which will never be zero, but is always some finite value even with an indefinite increase in velocity. Unfortunately, however, the rapid change in the coefficient of friction takes place during the range of velocities that are encountered in service.

The variation in friction with velocity has been expressed by the formula $F = \dfrac{.326}{1 + .035\,V}$. Such a formula gives a coefficient of friction at 60 miles an hour of .105 and at five miles per hour of .277. Since the retarding force is directly proportional to the coefficient of friction, the retarding force at five miles per hour would be almost three times the retarding force at 60 miles per hour. It should be stated, however, that this formula shows the variation in the coefficient of friction for velocity only and does not consider the pressure or the time of rubbing, both of which factors are present in service and which modify the value of the coefficient so that the formula above has no practical utility.

The decline in the coefficient of friction, due to continued rubbing, appears to be caused by the work done upon the shoe and is presumably some function of the work done. The decline due to continued rubbing is of practical importance because it has been found that an increase in pressure on the brake shoe does not bring the reduction in stopping distance that would be expected if the coefficient of friction were independent of the amount of work done upon the brake shoe. As has been mentioned, during the extensive Pennsylvania-Westinghouse brake tests, made near Atlantic City, N. J., in 1913, it was found that for an increase of five per cent in the brake shoe pressure, the stopping distance was decreased by about two per cent. Such a relationship held for the range of pressures used during these particular tests but might not apply for a wider range of pressures.

This decrease in the coefficient of friction with the amount of work done upon the brake shoe, explains why it is much more difficult to stop the modern train in a given distance than was the case many years ago. Indeed, the most elaborate brake equipment of the present day does not bring about a stop in a distance much less than was required many years ago with simpler air brake equipment and foundation brake rigging of a much lower degree of refinement. The increase in train speeds greatly increased the work done by the brake shoe since the energy to be absorbed by the shoes varies as the square of the velocity. Increase in car weight also increased the work to be done by the brake shoe so that much higher brake shoe pressures are required to produce the same stop distance that was secured when velocities and car weights were less.

It will also be noted that the variation in the coefficient of friction is contrary to what is desired in a brake shoe. To produce a short stop, the retarding force should be greatest when the velocity is highest. If the retardation is made high when the velocity is high through the application of very heavy shoe pressures, then the retardation becomes so great when the velocities are low as to cause the wheels to slide. Stops in actual service, therefore, are much longer than would be the case if the retardation existing toward the end of the stop could be obtained toward the commencement of the stop.

The thought will probably occur that such a condition could be met by applying a very heavy shoe pressure at the beginning of the stop and gradually diminishing this pressure as the stop proceeded with a consequent increase in the coefficient of friction. Actually, however, such an arrangement presents practical difficulties in the way of reducing the pressure for the many varied conditions that are found in actual service. Moreover, the pressures which would have to be applied toward the beginning of the stop are extremely high. It is the practice with modern passenger equipment cars to apply to the brake shoes during emergency brake applications, a pressure which is 150 per cent of the empty car weight before taking into account any losses in its transmission from the brake cylinder. As the modern dining car will weigh about 75 tons, such a car will have during an emergency application, a total nominal brake shoe pressure of 105

tons. If this pressure is to be much augmented, it will be evident that either the brake cylinder piston area will have to be increased or that the pressure exerted in the brake cylinder will have to be much beyond that now used. Either method would present very great practical difficulties with equipment as it now exists.

Air brake equipment possesses many different characteristics depending upon the type of vehicle, the kind of service and other operating conditions of this same character. Many of the functions are common, however, to all equipment. For this reason, the different functions in common use will be examined with some comment as to the reasons for their existence.

### Steps in the development of the air brake

Tests made by the M. C. B. Association on the Chicago, Burlington & Quincy in 1886 indicated conclusively that improvements in air brakes were necessary to meet the changed conditions since the invention of the first plain triple valve. Obviously, with a plain triple valve, the brake on the first car applies first, the brake on the second car, second, and so on, in order. With an emergency application the shock resulting was extreme even with the light weight cars used in 1886.

To meet the need for a greater rapidity of brake application, the quick action triple valve was invented. This triple valve consisted of the plain triple valve with an additional piston and valve. With this triple valve, whenever the brake pipe reduction was accomplished at an emergency rate or at a rate much in excess of that used in service, this additional valve was opened so as to connect the brake pipe to the brake cylinder. On account of these numerous passages through which brake pipe pressures could be reduced, the brake pipe reduction was accomplished in much less time than had theretofore been the case and in addition, with a greater uniformity throughout the train. With the quick action triple valve, it is possible to pass a brake application throughout a train at the rate of about 600 ft. per second. When it is considered that this rate is about one-half the velocity of sound it will be appreciated that the quick action triple applies the brakes throughout a long train with a rapidity which does not leave a great deal to be desired.

The quick action triple met the needs of service for a number of years. The next improvement in brake equipment was also in the direction of greater flexibility. The brake valves up to the time considered, had been simple forms of cocks with which the brake pipe was opened directly to the atmosphere when a brake application was wanted. It was found with long trains, that if the brake pipe was quickly opened to atmosphere and then as quickly cut off from atmosphere, a surge in the brake pipe pressure resulted which would cause the head brakes to release on account of the rush of air toward the head end of the train setting up a pressure sufficient to bring about a release. To overcome this condition, the equalizing piston was invented. With the equalizing piston goes an equalizing reservoir which is normally charged to brake pipe pressure. Pressure from the equalizing reservoir acts upon the top of the equalizing piston. The other side of the equalizing piston is open to the brake pipe and carries a stem which is normally held against its atmospheric seat. With a reduction in equalizing reservoir pressure, the equalizing piston lifts and permits brake pipe air to escape to atmosphere. The lift of the equalizing piston is a function of the train length. The opening between the brake pipe and the atmosphere is thus adjusted to the train length and moreover this opening is made or closed gradually so that objectionable surges and waves are not set up in the brake pipe.

The effectiveness of the brake was sufficient for service requirements until the early 90's when passenger trains were operated at higher speeds than had up to this time been used and the stopping distance was consequently increased. The effectiveness of the brake at this time was bettered by raising the brake pipe pressure from the 70 lb. which had been used, up to the 90 lb. or 110 lb., characteristic of present day service. As a result, the pressure obtainable in the brake cylinder was increased some 70 per cent. If this pressure were held continuously during an emergency stop, with the light equipment used at the time, the wheels were apt to slide toward the end of the stop on account of the increase in the coefficient of friction. To prevent such wheel sliding a high speed reducing valve was added to the equipment, the function of which was to reduce the brake cylinder pressure as the stop proceeded.

### Latter developments in air brake design

With the functions that have so far been discussed, the brake equipment satisfactorily met service conditions for a period up to the beginning of the present century. Then the need for both greater flexibility and effectiveness became apparent. The addition of the quick action function improved the rapidity with which an emergency application throughout the train could be secured but did nothing toward increasing the rapidity of a service application. As train lengths increased, particularly with freight trains, the delay in securing a brake application became very objectionable. To hasten the brake application throughout the train and to make it more uniform, triple valves were changed so as to include a function known as the quick service function. This is similar to the quick action function except that it is utilized only during a service application and the quick action function only during an emergency application. When triple valves take up the quick service position, communication is made on each car between the brake pipe and the brake cylinder. Consequently, the brake pipe pressure is reduced more rapidly and more uniformly than would be the case if the reduction had to be accomplished by all of the air escaping from the engineman's brake valve. The quick service function is needed for present day conditions and is included or can be included with all modern equipment. As indicating the rapidity of brake application brought about by the quick service function, it may be noted that tests made on the Virginian Railway in 1920 showed that a service application throughout a long freight train could be brought about at the rate of 294 ft. per sec. or approximately one-half the emergency rate.

### Difficulties encountered in braking long freight trains

Long freight trains had shown the need, not only for a function which would apply the brakes more rapidly and more uniformly, but also for a function which would cause a more uniform release. The pressure in the brake pipe is controlled by the engineman so that when it is desired to increase the brake pipe pressure, pipe friction causes a higher pressure to be built up at the head end of a train than at the rear. Consequently, the brakes at the head end of a train release before those at the rear. If the head cars are permitted to run with only a partial brake and the cars at the rear are being retarded with a more effective brake, the cars at the rear will tend to pull away from those at the head and under some conditions the stresses set up may be sufficient to cause the train to part.

Advantage was taken of the fact that the pressures at the head end of the train are higher than those at the rear during release. The triple valve was so modified that this higher pressure could be utilized to force the

triple to what is known as retarded release position. In this position the release of brake cylinder pressure is through a restricted opening so that the release throughout the train is substantially uniform.

This high pressure at the head end of the train also gave difficulty in that the auxiliary reservoirs at the head end were overcharged as compared with those at the rear. In order to restore the brake pipe pressure promptly with a long train, the release position of the brake valve permits main reservoir pressure to pass directly to the brake pipe. Since the main reservoir pressure is higher than the normal brake pipe pressure, the brakes at the head end of the train would reapply when the brake pipe pressure had reduced to normal. Such a condition was overcome by designing the triple valve so that when it took up retarded release position, the charging of the reservoirs was accomplished through a restricted port. The charging of the head reservoirs was, therefore, at a lower rate than obtained for the reservoirs at the rear. As a consequence, the charging of the reservoirs throughout the train was made substantially uniform.

These two functions of retarded release and retarded recharge apply to freight equipments but are not required with passenger equipments because passenger trains are shorter than freight trains. The quick service and quick action functions apply, however, to both passenger and freight car service.

### Increasing passenger car weights and speeds require more efficient brakes

As train weights became greater, difficulty was encountered in holding down the emergency stopping distance. An increase in car weights decreased the coefficient of friction which in turn increased the stop distance. It was found that the work done upon the brake shoe was so great that the increase in the coefficient of friction with decrease in speed was not sufficient to cause objectionable wheel sliding toward the end of the stop. As a result passenger triples were so designed that a high emergency cylinder pressure was obtainable and this pressure was held throughout the stop without reduction. The service cylinder pressure was limited by a safety valve but this safety valve was cut off during an emergency application. To secure the high emergency cylinder pressure, an additional reservoir known as the supplementary reservoir was added to the car brake equipment. From a normal brake pipe pressure of 110 lb., it was possible to secure an emergency cylinder pressure of 100 lb. This higher emergency cylinder pressure made it possible to keep the emergency stopping distance down to the values which had existed with lighter cars.

Increasing severity of service operations also indicated the need for more flexible brake operation with respect to the release. With the early forms of triple valves it was not possible to make a partial release of the brakes. Addition of the supplementary reservoir made it possible to add the graduated release function. This function was accomplished because the supplementary reservoir was not drawn upon during a service application and its pressure, therefore, could be made to return the triple piston toward service position when this was desired.

### Improvements in triple valve operation

Increasing difficulty was encountered in keeping down the emergency stopping distance as car weights became greater. To meet this need, control and universal valves were designed. The universal valve is now included in standard passenger car brake equipment. It differs radically from the earlier forms of triple valves in that separate parts are provided for service applications and emergency applications. With the earlier forms of triple valves, they might take up emergency position when only service position was intended. To prevent such an occurrence, the universal valve was designed with the service and emergency elements entirely separate so that the action of one would not affect the action of the other. In order to secure the effectiveness wanted, the emergency portion was designed with large ports and passages and with parts so constructed that the emergency cylinder pressure could be realized in the very shortest time. With the universal valve, a pressure of 100 lb. in the brake cylinder can be developed from 110 lb. brake pipe pressure in approximately two seconds. With the earlier forms of triple valves, it had not been possible to secure the quick action function if a service application had been made immediately before quick action was wanted. The universal valve differs from these earlier triple valves in that it is possible to secure quick action and high emergency cylinder pressure at any time regardless of whether a service application has previously been made.

### The locomotive brake equipment

When service conditions were less exacting, the locomotive brake equipment was essentially a car equipment with apparatus super-imposed for providing compressed air and giving control of it to the engineman. To meet the requirements of improved service, however, an equipment was designed which provided for a more complete control of the locomotive brakes, either independently or in conjunction with the train brakes as desired. Instead of a triple valve, a distributing valve was employed.

The distributing valve acts in a manner corresponding to the plain triple valve to develop pressure in a cylinder in accordance with the intention of the engineman. A piston in this cylinder allows main reservoir air to pass to the brake cylinders and build up in them a pressure corresponding to that existing in the distributing valve cylinder. With such an arrangement the same distributing valve can be used for all classes of locomotives, regardless of their weight. Moreover, space is conserved because auxiliary reservoirs are not required since the brake cylinder air is secured directly from the main reservoirs. The distributing valve does not require in itself the quick action or quick service functions because it is located on the locomotive. The distributing valve does, however, have the function of high emergency cylinder pressure so that the emergency stop distance of the train may be made as short as possible.

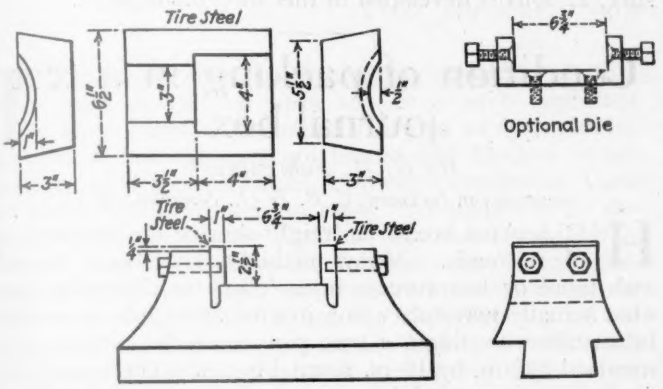
One difficulty in recent years has been the insuring of quick action passing throughout a train. When locomotives were smaller than is the case today, movement of the engineman's brake valve to emergency position developed a reduction in brake pipe pressure on the first car at an emergency rate. As the distance between the engineman's brake valve and the air actuated device on the first car increased, it became more difficult to secure an emergency rate of reduction on the first car, which was needed in order to start quick action functioning on the train. To overcome this condition, a vent valve was added to the locomotive equipment. This vent valve is an intermediate device which acts as a relay to insure that the rate of reduction on the first car will be an emergency rate whenever the brake value is placed in emergency operating position.

### Air brake equipment for electric locomotives

The foregoing comments have applied in greater or less degree to all air brake equipments. To meet special operating conditions, many air brake equipments have been devised which have incorporated in them functions quite different from those that have been discussed.

# Coupler repairs—Shop made pneumatic press

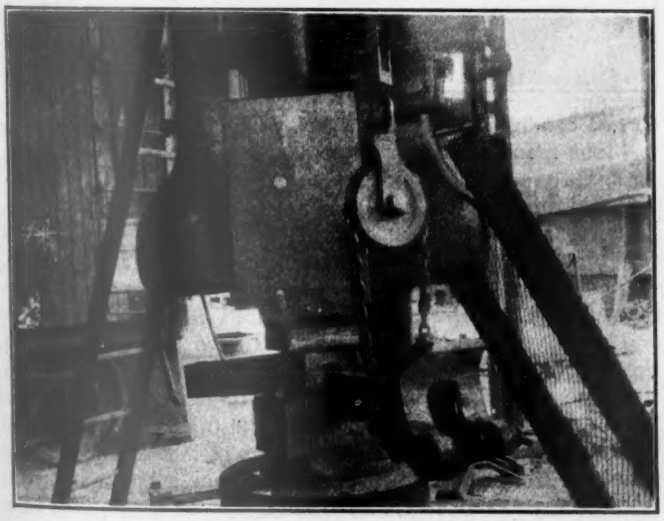
COUPLER repair work at large car shops and even at some of those of medium or small output forms one important detail of the total work of overhauling freight and passenger cars and conditioning them for further service. It is obvious that the best results are secured where the coupler work for a railroad system is concentrated at a relatively few points having properly




**Dies for shearing coupler rivets under a 1500-lb. steam hammer —Optional die gives less difficulty from working loose under hammer blows**

trained men and equipment for the most efficient handling of the work. From a safety standpoint and that of possible delays to service, couplers are one of the most important of car parts and they must be maintained in accordance with prescribed standards found by experience to reduce to a minimum the possibility of rapid wear, or failure.

Some of the equipment for handling coupler repair work at one of the largest car shops in the Southwest is



**Operation of shearing coupler rivets under 1500-lb. Morgan steam hammer equipped with special dies—guard protects hammer operator**

shown in the illustration. Approximately 850 couplers per month are overhauled at this point, being mostly of the American Railway Association standard "D" type. The couplers consist of coupler body, draft yoke and vertical thimble, assembled with three 1¼-in. rivets in the case of the lighter couplers and four rivets for the heavier ones. These couplers are stripped, usable parts reclaimed, annealed, re-assembled and riveted, then being ready for application to the cars on the outbound track.

The stripping operation consists of placing the coupler on a special die under the Morgan 1500-lb. steam hammer illustrated, the rivets being sheared and the coupler body separated from the draft yoke usually by a single blow of the hammer. A differential chain hoist suspended from a jib crane above the hammer supports the outer end of the coupler while the rivets are being sheared and enables the coupler to be handled with a minimum of physical effort. It will be noted from the illustration that a guard serves to protect the hammer operator from possible injury due to flying rivet heads. Referring to the drawing, the construction of the hammer dies will be evident. Under the action of the hammer the top die forces the coupler into the recess in the bottom die, securely keyed to the hammer base, shearing the holding rivets at a single blow. This work is handled by one hammer operator and two helpers, the production averaging about 20 couplers stripped per hour.

To remove the vertical thimbles the heads of the holding rivets are cut off by the oxy-acetylene cutting torch and the rivet bodies backed out with a handle punch and

**Station where coupler thimble rivet heads are cut off with a torch and rivets backed out with a handle punch and sledge**

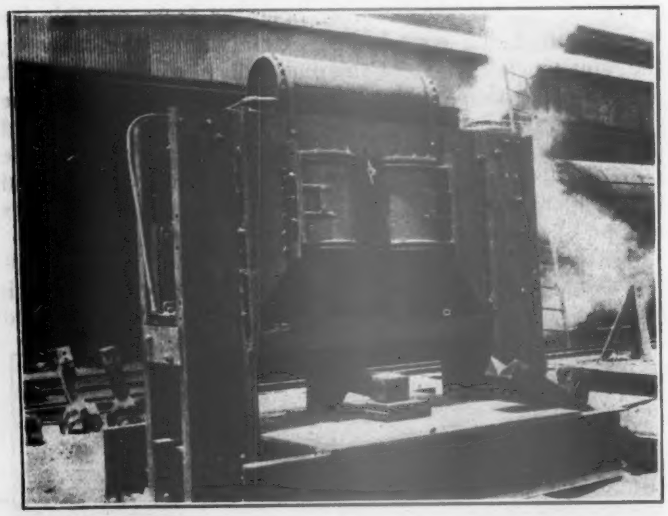
sledge hammer in the hands of helpers. The reason for this is that the vertical thimbles are of malleable iron and would not, in the majority of cases, stand a blow sufficient to shear the rivets under the steam hammer. Following the stripping operation, the rivet heads are punched out of the yoke and broken pieces of the rivets from the coupler shanks. It will be noted from another of the illustrations that two rails set in the ground serve as a convenient and substantial support for couplers while rivets are being backed out.

When not too badly worn, coupler shanks, knuckle and lock pin bearing surfaces are built up by electric welding. When bent, the coupler shanks are straightened hot under the pneumatic press illustrated, the couplers then being carefully annealed, reassembled with a new yoke and thimble when needed, and riveted in a 70-ton Hanna pneumatic riveting machine, also used for riveting draft lugs on sill splices and other similar work. The arrangement of the equipment for assembling couplers is such as to minimize the labor of handling and enable the maximum output to be obtained. The couplers are readily handled to the riveting machine by two men, and a special forge capable of heating 35 of the big rivets at a time assures an adequate supply of rivets when needed. Coke

reclaimed from the blacksmith fires is used in the furnace.

The average cost of reclaiming couplers at this point is $2.33 apiece, including the labor of stripping, handling to and from the welders and in and out of the annealing furnaces, and the cost of the oxy-acetylene gas cutting torch and operator. Draft yokes are reclaimed at an average total cost of $1.34 apiece.

The pneumatic press, shown in one of the illustrations straightening a coupler shank, has proved very valuable at this car repair point for forming sill splice patches; straightening truck sides without heating by the use of



**Shop made pneumatic press designed to be economical in the use of air and provide pressures up to 22 tons with 90-lb. air pressure**

oak blocking with a straight edge and gage; straightening coupler shanks hot; straightening angles cold, using top and bottom V-blocks; and many other operations in connection with steel car repair work. It is said to be economical in the use of air, being usually operated when air consumption in other parts of the shop is not heavy.

**Reclaimed couplers ready for the application of knuckles, knuckle pins and locking mechanism**

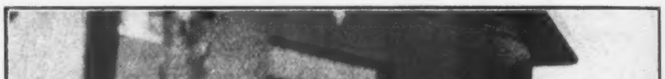
This pneumatic press is made entirely from scrap steel car parts. It is built up of angles and 15-in. channels supporting two 18-in. passenger car air brake cylinders which operate the equalizer and V-block. The piping arrangement is such that the pressure between the cylinders is equalized and the pistons move downward together. A distance of 5 ft. 8 in. is provided between the columns, there being a working space of 10 in. under the V-block and 17 in. under the equalizer. The bed plate, 15/16 in. thick, is rigidly supported, as shown on two heavy channels. Two small 6-in. air brake cylinders, not shown in the illustration, serve to raise the equalizer and V-block. To secure economy in air consumption, air exhausted from the 18-in. cylinders into the reservoir on top of the press frame is used in these small lifting cylinders. As a safety feature, a by-pass in the piping provides for the admission of air direct from the main pipe line to the 6-in. cylinders when changing dies. With 90 lb. air pressure, 22 tons is developed in this shop made press.

# Condition of packing in a test journal box

*By G. H. Fahrenbruck*

*General car foreman, C. B. & Q., Sheridan, Wy.*

HOT journal boxes in freight service are common to all railroads. Many methods have been devised with more or less success in an effort to determine just what actually takes place in a journal box while in service. In an effort to obtain a true picture of the conditions, a standard 5½-in. by 10-in. journal box was cut in half and applied to journal L4 on an arch bar truck under a



**Glazed condition of a journal box packing in a test box after four months' service without receiving any attention**

100,000-lb. capacity steel gondola car used in coal service. The box was applied and sealed September 26, 1925, and ran for a period of four months or to January 26, 1926, without receiving any attention at terminals or by train crews. During the test the car ran 1,200 miles.

The accompanying illustration shows the condition of the box when removed from the journal. It was found that the top of the packing for the full length of the journal was glazed and dry. All the oil was in the packing and none in the bottom of the box. The glazed condition of the packing prevented capillary attraction of the oil to the journal and would have caused a hot box in a short time.

These conditions emphasized the importance of loosening up the packing at important inspection terminals and adding a little free oil which would be a step in the right direction of reducing hot boxes. However, if free oil is not used more often, then it would be well to consider the repacking of journal boxes at more frequent intervals than is now the practice. The reason for this suggestion is that old packing glazes over quickly and reworking the packing will do little or no good without pulling out the packing and repacking the box.

# The car inspector and freight claim prevention*

## Proper investigation by qualified employees would aid in fixing responsibility for damage

*By W. R. Rogers*
*Chief interchange inspector, Youngstown, Ohio*

THE proper loading, bracing and blocking of cars, both closed and open top, is a very important matter and to my mind it is just as essential for us to know that the cars are braced and blocked in accordance with the American Railway Association Code of Loading Rules as it is to know that there are no defective wheels under the car. It may not be absolutely necessary that the division car foremen, general car foremen and other mechanical supervisors know in detail the various rules covering the bracing and blocking of the various commodities that are transported by the railroads to all parts of the country, but I do feel that these supervisors should at least know the Loading Rule requirements for shipments originating in territories over which they have jurisdiction. Otherwise, how can the supervisors properly instruct the inspectors in matters pertaining to the loading of commodities that require special staking and blocking?

Loading Rules are not adopted without good and sufficient cause and then only after many experimental trial shipments have proved the feasibility of such loading. Many of the large shippers have had a great deal to do with formulating a number of the present rules and I have heard railroad officers make the remark that many of the shippers know more about proper bracing and blocking their shipments than we do. That statement is the truth but it is not the whole truth. Would it not have been better to have said, "Many shippers know more about the proper bracing and blocking of their commodities than some railroad men do." Do not misconstrue this statement to mean that some of the shippers do not know as much as the best of us know about proper loading, bracing and blocking their material, for such is not the thought. I just want to bring out that some of us know so little about the Loading Rule requirements that some shippers have it "all over us," so to speak, when it comes to proper bracing and blocking.

The carriers pay out annually enormous sums of money for loss and damage due to a variety of causes. Speaking of just two of these—rough handling and improper loading—who can say how much of the money paid out in loss and damage claims that are charged to rough handling should, if the truth were known, be charged to improper loading? And who can say how much of the amount is charged erroneously to improper loading? We have a number of special representatives, special agents, inspectors of depots and board walks, inspectors of this, that and the other; every one of them good fellows, with the very best of intentions conducting investigations and making reports based on their investigations and charging the amount of the claims to some cause other than the real cause. In order to make myself clear, I would just like to mention a few of the reasons given for certain loss and damage.

*Abstract of a paper presented before the Cleveland Steam Railway Club on March 1, 1926.

Recently I had some claim papers where the agent at destination stated that 16 sections of wrought iron pipe, which was a part of a possible two hundred sections in the car, were bent on account of being loaded in a car too long for the pipe. Can you imagine what the length of the car would have to do with the bending of that pipe?

In another case, the temporary side stakes broke on pipe shipments causing the pipe to spill off along the right-of-way. The person originating the report and giving the cause for the stakes breaking and the pipe falling off, stated that it was due to the fact that the stakes were placed on the inside against the car sides instead of in the stake pockets. Any person at all familiar with the loading of pipe knows that, when the stakes are placed in the stake pockets and wire is used to tie the opposite stakes together, which is the rule requirement, when the pipe shifts, as it invariably does, the stakes are very apt to snap off; whereas, if they are not placed in the stake pockets but placed on the inside of the car as permitted in the Rules, that dangerous condition is eliminated.

In another case a large scrap iron dealer loading a car load of sheet steel presented a claim for a large sum of money on account of rusted sheets. Where is the yardmaster that would furnish a scrap iron dealer a water proof car, or in other words a car fit for sheet steel, unless he had a special request for such a car?

Just one more case that I wish to make mention of—the president of a sheet manufacturing plant got in touch with the general freight office saying in part that the car inspector was tying up their shipments, refusing to accept them because they were not braced and blocked in accordance with some rules the car inspector had, and that the carrier's agent had expressed an opinion that the load was well braced and would no doubt protect the sheets to destination. I was asked to investigate and I called upon the agent, had him go with me to the car and open it up. I found in the first place that the car was unfit for high class sheet steel subject to damage if it became wet, because it was in a leaking condition. You could see daylight through it in several different places. The sheet steel in the car was rusted and the edges were bent. We are paying claims every day for such damage but in this case they were in that condition when placed in the car; the shipper acknowledged it. I asked the agent if the shipper was given a clear bill-of-lading and he said he did not know; that he would get the bill of lading and see. He came back with the information that the shipper had been given a clear bill-of-lading but he would make notation as to the real condition. There was nothing to prevent the consignee receiving the sheet steel from entering a claim for rusted and bent sheets, if he so desired, and the carrier could not produce an inspection record that the car was fit for sheet steel. Furthermore, the shipper had a clear bill-of-lading.

How much of this large amount is charged to improper

loading and defective equipment that the railroads are in no way responsible for? The president of the above referred to sheet manufacturing plant expressed a willingness to load in accordance with the Rules. I gave them the car inspector's Loading Rule book and the agent, car inspector and myself went into a car they were loading and I asked the agent for his Loading Rule Book, so I could show the men doing the bracing just how to install it. The agent handed me his rule book and I turned the pages over to the Sheet Rules. For a moment I thought I must be dreaming until I looked at the cover of the book and found that it was an issue of 1922 and the method of loading sheet steel has since been materially changed. The agent said that was the only book he had. How could that agent make a proper investigation at destination and say whether or not loads were properly braced and blocked when he did not have an up-to-date Loading Rule Book?

Consignees many times, upon the arrival of freight in a damaged condition on their sidings and unloading tracks, call upon the agent or a freight claim adjuster to make an inspection; possibly the agent himself makes the inspection. Does he know whether the car was originally improperly loaded or not? Does he know what the rules require; if he does not know, how can he make a proper statement as to the probable cause of the damage? Does the freight claim adjuster know the Loading Rule Requirements? How many thousands of dollars are charged to improper loading on reports furnished by employees who do not, in some instances, know that we have a Loading Rules Book? If the freight claim division of the American Railway Association were to insist that the freight agent at destination call upon a qualified mechanical representative to make an inspection and ascertain whether or not shipment was properly braced and blocked in accordance with the Loading Rules, would it help any toward getting at the true facts and placing the responsibility where it properly belongs? Would such action not permit an intelligent report of the true conditions with the possibility of correcting the condition at the originating point of loading and prevent some of this damage that goes on from day to day because the true facts and conditions are not developed?

I could go on for hours and recall cases where reports have been made giving reasons for loss and damage as "improperly braced and blocked," but I believe the few cases mentioned will convince anyone that proper investigations by employees who are fully qualified by their knowledge of the Loading Rules requirements is desired and necessary in order that the causes for loss and damage may be properly developed and the responsibility and cost be put where it properly belongs.

# Improper bills and wrong interpretations*

*By M. S. Belk*

*General air brake instructor, Southern Railway, Washington, D. C.*

I RECENTLY read some correspondence relating to five different bills for air brake work performed, concerning which 55 letters had been written. In no case did I consider any of the bills to be just, or in accordance with A. R. A. Rules, and they were ordered to be cancelled. If the files of all the railroads should be gone over, there is no doubt in my mind but that a large number of like cases would be found. It costs money to make out bills, it costs money to write letters, and when either is done unnecessarily, it properly comes under the head of "unnecessary expenses."

A foreign car brake on your repair track is cleaned, lubricated, tested and stencilled strictly in accordance with A. R. A. rules governing this work. A few days or a week thereafter, this car is on another road and an excessive leak has developed at the triple exhaust. The inspector considers the defects of sufficient importance to justify changing the triple. If he does, you know that in order to justify the charge, the work must be performed according to Rule 60. Even if this is not so, many roads will want to use the bill of the second road as joint evidence to show that the work was not properly performed by your road.

Men who are at all versed in the air brake art know, regardless of how well you may condition a triple valve that there are a number of disorders which are liable to occur at any moment after the valve is placed in service. Some of these disorders are leaky slide or emergency valves, leaky piston packing rings and excessive friction. We have every reason to believe that the triple valve manufacturers turn out new valves in as near 100 per cent condition as it is possible to put them, still we find many new valves which develop one or more of these disorders almost immediately after being placed in service; in fact, many become defective while being shipped. I am sure that you will agree with me, if I have stated the facts, that correspondence about such cases should come under the head of "unnecessary expense."

There are a large number of cases written about and concerning which joint evidence is taken of poor or improper workmanship, which consume time, and time in the major portion of cases means money expended. While I do not agree that it is altogether right, still it is my understanding of the A. R. A. Rules that there is only one ground upon which we may submit joint evidence and expect a bill to be cancelled, namely, "wrong repairs," except failure properly to obliterate the old stencilling in case of a second cleaning by the same road before the car reaches home. Submitting joint evidence about poor or improper workmanship so far as I know is not worth the card it is written on, much less the time it requires to procure it, so, in my opinion, this also comes under the head of unnecessary expense.

Considerable unnecessary correspondence between many roads, is caused by the many different interpretations being placed on the rule requiring the individual test of a brake after cleaning. Some understand this rule to mean that a car must be on a repair track where you have yard air pressure and the individual test made. If you have and use the proper single car testing device, and the brake is cleaned in accordance with Rule 60 the car could be placed anywhere in a 100-car train. With the proper testing device attached to the hose at the front of the car we have cleaned, and with the rear angle cock open but the cock closed on the next car in the train, charge the brake system fully to standard pressure, close the angle cock at the rear of the car immediately in front of the one cleaned and you can make just as accurate an individual test as if the car were on the repair track. What does it matter if the air comes from a yard compressor through a yard air line or from a locomotive compressor through the brake pipe of several cars? If I am correct in my interpretation, then why should not all this correspondence about how the individual test is made, come under the head of unnecessary expense?

I am advised of considerable correspondence about "in-date" brake cars on repair tracks for other repairs for which there is no labor charge. The brake is cleaned because the stencilled date is 10 months old. The owner asks for cancellation of the brake cleaning bill because no

*Abstract of a paper read at the January 16, 1926, meeting of the Southeastern Air Brake Club, Atlanta, Georgia.

other bill is submitted. All of us know, even if there are no labor charges, that if we shop a car for such repairs we must submit a bill and mark it "no bill." This will show that the car was not shopped exclusively for air brake cleaning. Every car when shopped for repairs should be given a thorough and proper air brake test, regardless of the last date of cleaning. If either the triple or cylinder is defective, we may clean them and charge for the work, unless the brake is cleaned by the same road within 60 days. In such cases, I would say remedy the defect and mark the bill "no bill."

If we try to interpret the rules so as to make them fit our own case just to justify a charge and later receive a like bill and refuse to accept it, we are not living up to the principle and intent of the American Railway Association Rules.

# Annual inspection report of safety appliances

THE report of the Director of the Bureau of Safety to the Interstate Commerce Commission for the fiscal year ending June 30, 1925, shows that during the year a total of 1,167,980 freight cars were inspected, of which 40,662, or 3.48 per cent, had defective safety appliances, a total of 50,395 defects being reported. There were 22,526 passenger cars inspected, of which 268, or 1.19 per cent, were found with defective safety appliances, a total of 514 defects being reported. A total of 23,664 locomotives were inspected, of which 496, or 2.1 per cent, had defective safety appliances, 664 defects being reported. The number of defects per thousand cars and locomotives inspected was 42.46 as compared with 52.73 for the preceding fiscal year. These figures are the totals of Table I shown in the report.

This table contains a list of the defective appliances on freight and passenger cars and locomotives reported by inspectors during the fiscal year, 1925. A summary of the more common defects listed in the table follows:

*Couplers*—A total of 2,835 coupler defects were reported, the most important groups of which were 1,601 worn bodies, 573 low couplers and 239 loose carrier arms. Only 127 broken coupler bodies were reported.

*Knuckles*—A total of 3,687 knuckle defects were reported of which 1,406 were worn knuckles, 1,073 worn knuckle pins, and 912 broken knuckle pins. A total of 93 broken knuckles were reported.

*Lock blocks*—A total of 5,222 lock block defects were reported which consisted principally of 1,519 worn lock blocks, 1,151 inoperative, 907 with the lock lift disconnected or missing and 305 lock lifts bent or broken.

*Uncoupling mechanism*—A total of 4,015 uncoupling mechanism defects were reported of which 379 uncoupling levers were bent, 513 wrong or incorrectly applied, 356 disconnected, 559 inoperative, 425 handles too low and 1,192 uncoupling chains broken.

*End locks*—The inspectors found 145 defective end locks.

*Keepers*—A total of 241 keepers were found defective, of which 169 were loose keepers.

*Visible parts of the air brake*—The inspectors found 18,839 defective visible parts of air brakes of which 3,995

**Causes of instances in which train-service employees remained on duty longer than 16 consecutive hours for the past five years.**

| Causes | 1921 | 1922 | 1923 | 1924 | 1925 |
|---|---|---|---|---|---|
| Collisions | 1,336 | 322 | 889 | 584 | 439 |
| Derailments | 15,066 | 5,670 | 9,203 | 7,533 | 4,557 |
| Track defects and obstructions | 704 | 224 | 391 | 299 | 142 |
| Landslides, high water, fire | 1,218 | 552 | 633 | 560 | 1,221 |
| Adverse weather conditions | 2,283 | 2,096 | 3,299 | 2,154 | 2,715 |
| Congestion of traffic | 1,048 | 325 | 1,071 | 402 | 670 |
| Station work, waiting for orders and meeting trains | 1,766 | 532 | 1,373 | 594 | 586 |
| Coupler and drawbar defects | 5,289 | 1.890 | 3,760 | 1.881 | 1,313 |
| Miscellaneous car defects | 4,527 | 1,405 | 2,939 | 1,473 | 805 |
| Hot boxes | 221 | 54 | 246 | 114 | 109 |
| Air troubles | 1,524 | 480 | 1,301 | 632 | 403 |
| Taking or running for water | 247 | 170 | 289 | 203 | 124 |
| Cleaning fires | 31 | 15 | 32 | 0 | 2 |
| Low steam: | | | | | |
| Poor coal | 206 | 26 | 94 | 27 | 21 |
| Bad water | 0 | 0 | 0 | 4 | 22 |
| Leaking | 424 | 97 | 640 | 134 | 41 |
| Miscellaneous locomotive mechanical defects | 1,941 | 720 | 2,885 | 716 | 604 |
| Wire troubles | 81 | 86 | 32 | 11 | 8 |
| Sickness, death, personal injury | 38 | 25 | 24 | 39 | 11 |
| Wrecking and relief service* | .... | 4,298 | 5,460 | 4,805 | 3,524 |
| Miscellaneous | 1,984 | 714 | 2,826 | 1,056 | 1,095 |
| Total | 39,934 | 19,701 | 37,387 | 23,221 | 18,412 |

* During the year 1921 instances of excess service caused by wreck ing and relief service were not segregated, but were included under such causes listed in this table as may have required the wrecking and relief service.

**A comparison of the results of safety appliance inspections with previous years.**

| | 1921 | 1922 | 1923 | 1924 | 1925 |
|---|---|---|---|---|---|
| Freight cars inspected | 865,858 | 1,046,964 | 1,117,355 | 1,128,258 | 1,167,980 |
| Per cent defective | 5.34 | 4.35 | 8.49 | 4.47 | 3.48 |
| Passenger cars inspected | 20,082 | 26,116 | 22,038 | 21,359 | 22,526 |
| Per cent defective | 0.87 | 0.97 | 1.27 | 1.54 | 1.19 |
| Locomotives inspected | 21,353 | 23,590 | 23,236 | 23,283 | 26,664 |
| Per cent defective | 2.80 | 2.40 | 3.64 | 2.89 | 2.10 |
| Number of defects per 1,000 inspected | 52.36 | 50.54 | 100.31 | 52.73 | 42.46 |

were air brakes cut out, 4,089 cylinders and triples not cleaned within 12 months, 1,516 loose brake pipes, 2,255 missing release rods, 500 defective or loose retaining valves, 1,861 defective retaining pipes, 769 with excessive piston travel, and 2,601 inoperative air brakes.

*Handholds*—A total of 3,589 handhold defects were reported of which 1,119 were bent, 525 loose, 551 missing, 312 with wrong dimensions, 449 with improper clearance and 483 applied incorrectly.

*Ladders*—The inspectors reported 1,873 defective ladders of which 632 were bent treads, 224 loose treads, 287 missing treads and 149 without footguards.

*Running boards*—A total of 2,661 running board defects were reported of which 678 were broken, 1,028 loose, 619 with loose braces and 113 with broken cleats.

*Brake shafts*—Of the 1,225 brake shafts reported defective 476 were bent, 130 were wrong dimensions and

**The number of freight and passenger cars and locomotives inspected, the number found to be defective, and the percentage defective each year for the past 10 years**

| Year | Inspected | Defective | Per cent defective |
|---|---|---|---|
| 1925 | 1,214,170 | 41,426 | 3.41 |
| 1924 | 1,172,900 | 51,387 | 4.38 |
| 1923 | 1,162,629 | 96,024 | 8.25 |
| 1922 | 1,096,670 | 46,370 | 4.22 |
| 1921 | 907,293 | 47,040 | 5.18 |
| 1920 | 911,537 | 40,416 | 4.40 |
| 1919 | 1,078,361 | 38,551 | 3.57 |
| 1918 | 1,119,451 | 42,448 | 3.79 |
| 1917 | 1,166,759 | 41,378 | 3.54 |
| 1916 | 967,507 | 35,372 | 3.65 |

399 were missing brake shaft cotter keys at the bottom or the brake shaft not properly secured to prevent it from raising out of the operating position.

*Brake wheels*—The inspectors reported a total of 616 defective brake wheels, the main item of which consisted of 442 with insufficient clearance.

*Ratchet wheels*—Of the total of 547 reported defective, 494 were loose.

*Brake pawls*—A total of 560 defective brake pawls were reported of which 279 were loose and 129 inoperative.

*Brake steps*—A total of 280 defective brake steps were reported of which 147 were broken and 76 loose.

*Brake chains*—The inspectors reported 848 defective brake chains of which 106 were disconnected, 294 were of wrong dimensions, and 347 were incorrectly secured to the shaft.

*Brake beams*—Of the total of 861 reported defective, 663 were defective beams or attachments and 132 missing brake shoes.

One of the tables in the report presents separately for individual railroads on which 500 or more cars were inspected, the number of defects reported for each of the 41 classifications of safety appliance defects. Another contains a list of the roads on which inspections of freight cars were made during the year, together with the number of cars inspected and the number and percentage found defective; similar figures for the same roads are also furnished for the four preceding years. These two tables disclose a representative condition of equipment during the past year, and furnish data for comparative purposes covering a five-year period.

Two other tables contain the results of tests of air brakes on trains made by the inspectors of the Bureau of Safety. One shows that during the year air brake tests were made on 2,166 trains made up for departure from terminals, these trains consisting of 75,883 cars; air brakes were found operative on 74,748 of these cars, the average percentage of cars in trains which were controlled by air brakes being 98 per cent. The other shows that during the year air brake tests were made on 935 trains arriving at terminals, these trains consisting of 38,782 cars; air brakes were found operative on 36,624 of these cars, the average percentage of the cars in the trains which were controlled by air brakes being 94.

### Hours of service

During the year ended June 30, 1925, hours-of-service reports were filed by 1,148 railroads. Of these railroads 788 filed reports showing that no service in excess of the limitations prescribed by law was performed by their employees; the other 360 railroads reported a total of 37,497 instances of all classes of excess service. As compared with the previous year this is a decrease of 10,725 instances, or a reduction of 22.2 per cent.

The causes of instances in which train-service employees remained on duty longer than 16 consecutive hours, as shown by the Statistical Analysis of Carriers' Monthly Hours of Service Reports for the past five fiscal years, have been arranged in the table for the purpose of comparison.

The foregoing table shows a decrease of 4,809 instances in which employees remained on duty longer than 16 consecutive hours as compared with the number reported for the preceding year, a reduction of 20.7 per cent.

## Decisions of the Arbitration Committee

*(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)*

### Responsibility divided on same pair of wheels

On October 20, 1923, the Chicago, Burlington & Quincy issued a defect card for a cut journal under Southern car No. 269136 when it was delivered to the Union Pacific. The U. P. when changing the wheels found one wheel to be scrap because of brake burns and the other wheel condemnable by use of the remounting gage because of a warm flange. The U. P. rendered a bill to the C. B. & Q. for the labor, brasses, box bolts and the difference in value between the one wheel condemned by use of the remounting gage and the new wheel applied. The difference in value between the other wheel, which was condemned on account of brake burns and the new wheel applied, was charged to the car owner. The handling line contended that a wheel condemned by the use of remounting gage when associated with an owner's defect on the mate wheel, is chargeable to the car owner regardless of the association of a cut journal on the axle with the same wheels. The owner maintained that Interpretation 3 of Rule 98, places the responsibility for the wheel condemned by the remounting gage with the company responsible for the wheel exchange regardless of the fact that the mate wheel may have owner's defects.

The Arbitration Committee rendered the following decision: "In such cases of divided responsibility on the same pair of wheels, the responsibility for delivering line defects included the wheel flange condemned by the remounting gage, as intended in Interpretation No. 3 to Rule 98. Therefore, the contention of the Union Pacific is sustained."—*Case No.* 1353, *Union Pacific vs. Chicago, Burlington & Quincy.*


# Reclaiming locomotive main rods

## Rods weakened by repeated reaming operations are restored to original strength by Thermit welding

*By Joseph Murphy*

*General foreman, Boston & Albany, West Springfield, Mass.*

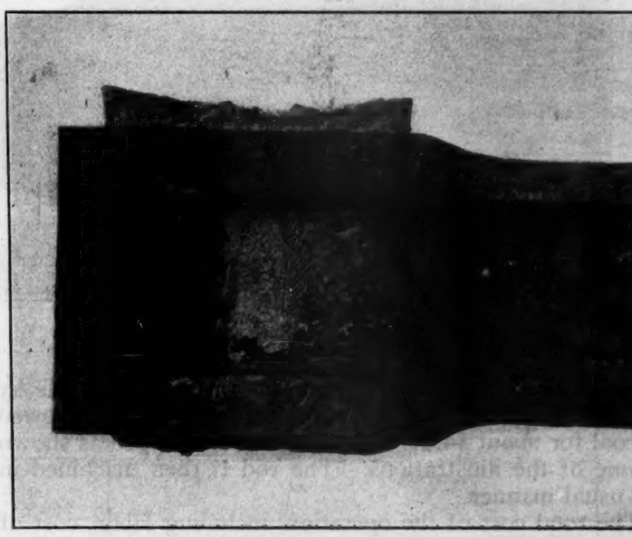
A STEEL back end main rod strap is difficult to hold securely owing to the heavy stresses set up in the reciprocating parts of a locomotive. In time, owing to repeated reaming at each shopping, the holes become so large that both the rod and strap are weakened to such an extent that they cannot be continued in service.

**The top view shows the wax mold in place while the lower view shows the mold box and the position of the wooden riser plug**

About three years ago we conceived the idea of filling these holes with thermit steel and reclaiming the rod by a process which has proved satisfactory and profitable.

### Preparing the rod

The stub end of the rod is thoroughly cleaned and three wooden plugs are driven into the holes at the small end of the taper. The plugs are waxed, as shown in one of the illustrations. The rod is then placed so that the plugs

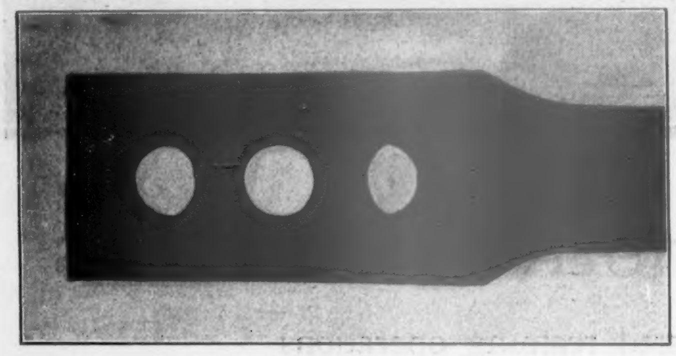


**The appearance of the weld before machining**

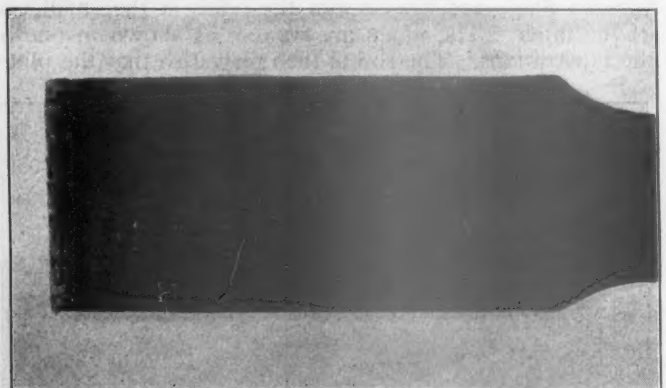
are on the bottom. A sheet steel box 14 in. long, 10 in. wide and 14 in. deep, constructed of 3/16-in. steel is set on the end of the stub so that there is a clearance of about 2 in. between the rod and the bottom of the box to allow for the ramming of the sand under the rod. This box

serves to hold the mold which is built around the rod. The sand is rammed at the bottom and sides to the top of the rod. A wooden block is then placed over the holes, the base of this plug being sufficiently wide to project about ¼ in. beyond each side of the holes. The sand is then rammed around this block, and the edge of the mold dented to prevent the metal and slag from flowing over the box. The plug is then removed, thus forming a riser for the metal. The end of the rod with the box and mold is then inserted into an oil furnace and allowed to heat for two hours to bring the temperature to 1,550 deg. F.

While the rod is heating the welder prepares his crucible. About 40 lb. of railroad thermit is charged into the crucible, the ignition powder placed on top and the cover applied, after which the crucible is suspended from a jib crane to allow for adjustments. The rod is then removed from the furnace, levelled and all particles of sand and scale blown out of the holes. The crucible is then adjusted so that the tap is directly over the riser and high enough so that it can be swung over, if necessary after tapping the mold. The reaction is started and 25 to 30 seconds later the crucible is tapped. The plugs which have been burned during the preheating rise to the top, allowing the thermit metal to fill the impression made by them at the bottom of the mold. The weld is then allowed to cool for about 14 hr. after which it is stripped as shown in one of the illustrations. The rod is then machined in the usual manner.



**The stub end of the rod thoroughly cleaned preparatory to the Thermit weld**



**The rod looks like a new one after machining**

The total cost of the operation, including labor, cost of material and subsequent machining, is $24.50 a rod. The cost of a new rod is approximately $136, showing a saving of about $111.50 a rod.

### The effect of high temperatures on original steel

When we first started to use this process it was suggested that the high temperature of the thermit steel might have a deteriorating effect on the structure of the original steel with the possible result of a rod failure on the road. As a result of the suggestion we made a test which proved to our satisfaction that such a condition did not actually occur.

A rod was prepared in the ordinary way; that is, the mold was built around the butt end and this portion of the rod, together with the mold, was preheated in the furnace to about 1,500 deg. F. The thermit was then poured and the mold allowed to cool for 14 hours before stripping. This permitted the welded end to cool slowly and refine the grain.

After stripping the mold, the entire rod was annealed after which 1-in. holes were drilled through the poured thermit. The butt end was then cut in two, splitting it longitudinally. The piece was also fractured at the point where the weld was made. It was found that the weld was perfect and homogeneous. A specimen was cut off the portion of the rod containing the original steel, fractured, and the grain at the fracture compared with the fracture across the weld. It was found that the grain had not become coarser on account of the extreme thermit heat and was practically like the original stock. Several scleroscope hardness tests were made. The welded specimen tested 29 hard, while the original stock tested 31 hard, the difference of which is of no moment.

Providing that the mold after pouring is allowed to cool slowly before stripping, the steel has a tendency to refine its grain and will have practically the same structure as the original stock of the rod. The lower scleroscope reading on the welded metal is undoubtedly due to the fact that the material in this section of the rod had been annealed twice and was a trifle softer.

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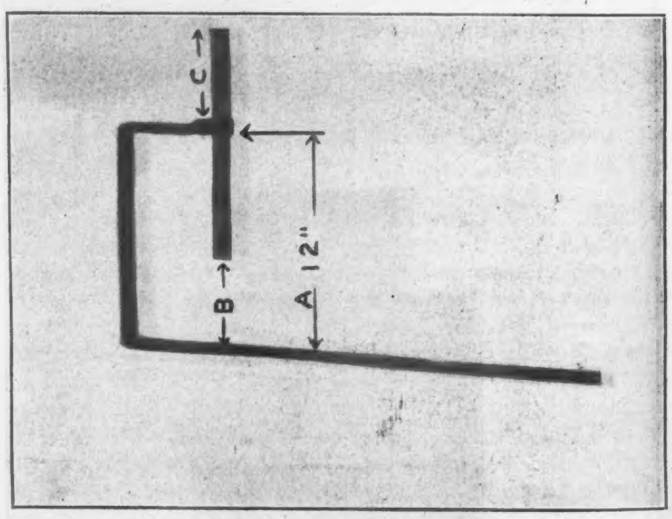
# Crown brass and saddle seat gage

*By J. R. Phelps*

*Apprentice instructor, A. T. & S. F. shops, San Bernardino, Cal.*

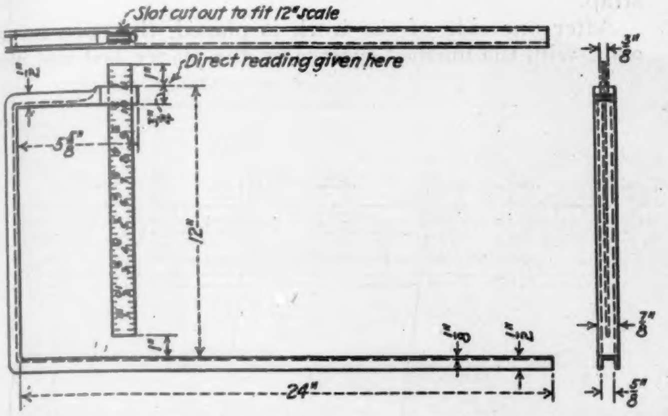
THE accompanying illustrations show a gage for giving a direct reading of the distance from the crown of the driving box brass to the saddle seat. As shown in the photograph, the distance marked *A* is just 12 in. and




**As the rule is moved the distance B and C is always equal**

by placing a 12 in. scale in the slot of the gage the distance *B* and *C* will always equal each other. Consequently, by placing the gage on the driving box, the

amount the scale extends through the slot in the gage will be the distance from the crown of the driving box brass to the saddle seat. This gives a direct reading and




**Gage for measuring the distance from the driving box saddle to the crown of the brass**

eliminates the chances of error so likely to occur in the old way of using straight edges and substracting the one distance from the other.

# Hydraulic jib crane for the boiler shop

*By H. J. Raps*

*General boiler foreman, Burnside shops, Illinois Central, Chicago*

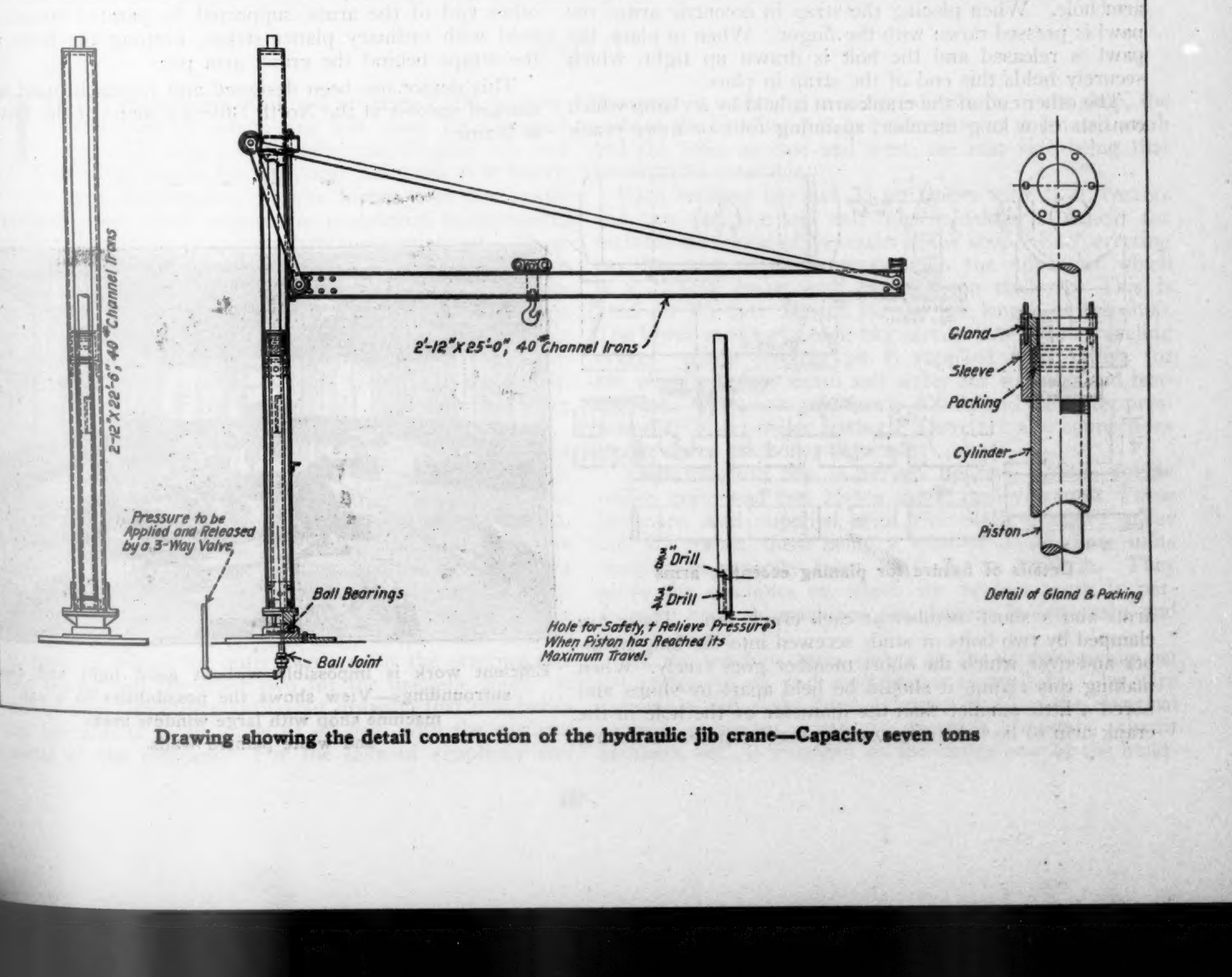
An improved design of jib crane as compared to those of the usual type, has recently been installed in the Burnside shops of the Illinois Central, Chicago. This crane is equipped with a boom which can be raised or lowered to any height desired, by hydraulic pressure. The cylinder is of 5¼-in. inside diameter, made of 7/16-in. sheet metal, and is located between the two channels composing the mast. The piston is 4½ in. in diameter and operates a piston rod secured directly to the main truss rod support of the boom. Referring to the drawing, the weight of the load on the main truss rod is carried on a roller which runs on the side of the mast. The thrust of the boom is carried on another roller which runs on the opposite side of the mast. Pressure in the cylinder is regulated by means of a three-way valve equipped with a lever handle located in a position convenient for the operator. The pressure maintained in the cylinder while the crane is in use is from 1,000 to 1,200 lb. per sq. in. The bottom end of the mast is carried on ball bearings.

The manner of raising the boom is a considerable improvement over jib cranes of similar design. On designs of jib cranes previously used in these shops, the boom was extended between the two channels composing the boom, and the piston connected directly to the boom. In the new design, the piston connection is opposite the upper sheaves, which increases the capacity of the crane.

The details for this crane were worked out by Joe Millray, assistant boiler foreman, and Frank Cummings, machine shop foreman, under the supervision of Frank P. Nash, general foreman, Burnside shops.

# Fixture for planing eccentric arms

The fixture, shown in the accompanying illustrations, for planing eccentric crank arms is simple, solid and quickly set up so as to leave the top surface clear for the use of two planer heads. The essential parts of the fixture are the eight expansion straps and grips. A loose part, or a pawl, forms one end of the strap. The angles at which these pawls are cut are not essential




**Drawing showing the detail construction of the hydraulic jib crane—Capacity seven tons**

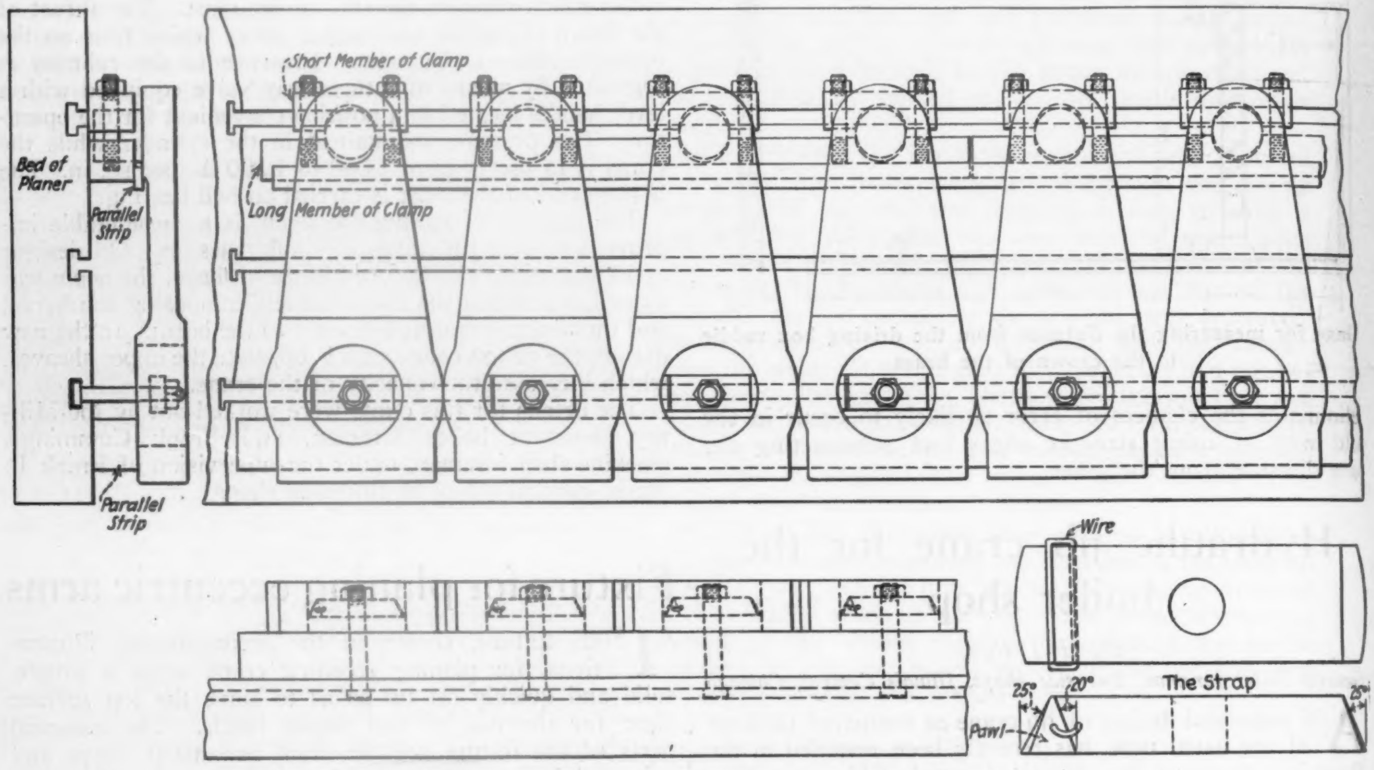
but have been found to work well. A No. 30 hole drilled through the pawl and the strap allows the pawl to be wired to the strap with spring wire which insures it being in place.

The end of the strap and the pawl are rounded to approximate the hole in the eccentric arm. The length of the strap plus the pawl is the diameter of the eccentric arm hole. When placing the strap in eccentric arms, the pawl is pressed down with the finger. When in place, the pawl is released and the bolt is drawn up tight, which securely holds this end of the strap in place.

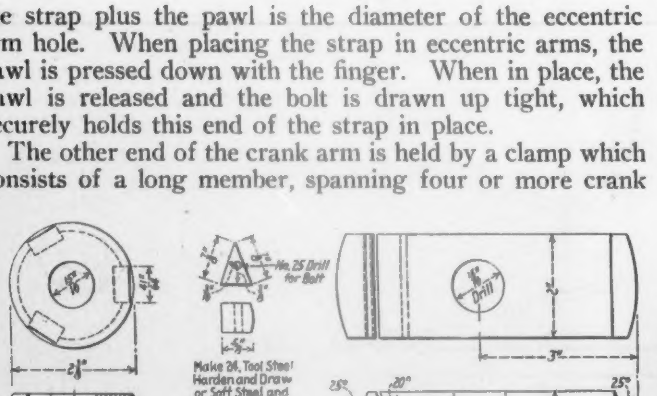
The other end of the crank arm is held by a clamp which consists of a long member, spanning four or more crank arms and a short member at each crank pin. These are clamped by two bolts or studs screwed into the long member and over which the short member goes freely. When making this clamp, it should be held apart by shims and bored a little smaller than the diameter of the hole in the crank arm to be held. Two clamping straps to each long clamp member will be found sufficient to hold the work to the planer. The large end of each crank arm is held to the planer bed by a ⅞-in. bolt through the expansion strap.

After one side of the work is planed, they are turned over, with the finished surface on the planer bed and with the expansion straps still in the crank arm holes. The other end of the arms, supported by parallel straps, are held with ordinary planer straps, keeping the bolts and the straps behind the crank arm pin.

This device has been designed and regularly used with marked success at the North Billerica shops of the Boston & Maine.




**Method of mounting eccentric arms on the planer bed**




**Details of fixture for planing eccentric arms**

**Efficient work is impossible without good light and clean surroundings—View shows the possibilities in a car machine shop with large window areas and white painted walls**

*General view of the Pennsylvania Juniata locomotive repair shop, showing the two welfare buildings, one at each end of the east side of the shop*

# Repairing locomotives at Pennsylvania Railroad Juniata shop

## Scheduling system, material delivery, inspection methods, and standardized repair parts, outstanding features

### Part I

THE Pennsylvania Railroad operates 7,103 locomotives, among which are 598 class I1s Decapod type, 574 class L1s Mikado type, 60 class N1s and 130 Class N2s Santa Fe type, and 325 class K4s heavy Pacific type locomotives. These locomotives are heavy modern power which require, for economical maintenance, modern shop facilities and machine tool equipment. Many of the smaller shops in which these locomotives were repaired were not properly equipped to handle them to say nothing of the fact that the full capacity of these shops was needed to handle other classes of power. As a result of these conditions, it was decided to build a locomotive repair shop embodying features of design and equipment, especially adapted to handle the types of locomotives above enumerated.

The new facilities, shown in heavy lines in the plant layout drawing, which consist of an erecting and machine shop building, a flue shop, a carpenter shop, a storehouse, two welfare buildings, a power house, a 110-ft. turntable and two outside overhead crane runways, are additions to the previously existing facilities of the Juniata shops, located east of the city limits of Altoona, Pa. The erecting and machine shop, which is of the transverse type is 691 ft. long and 346 ft. wide and is divided into four 85 ft. bays, of which the outer two are for the erecting pits and tracks and the inner two for the machine shop. It will be seen from the plant layout drawing that this building lies almost at an angle of 45 deg. with the cardinal points of the compass. For the sake of simplicity and clearness in referring to various locations in the shop, the ends of the building will be referred to as north and south and the sides as east and west, the east side being that towards the turntable.

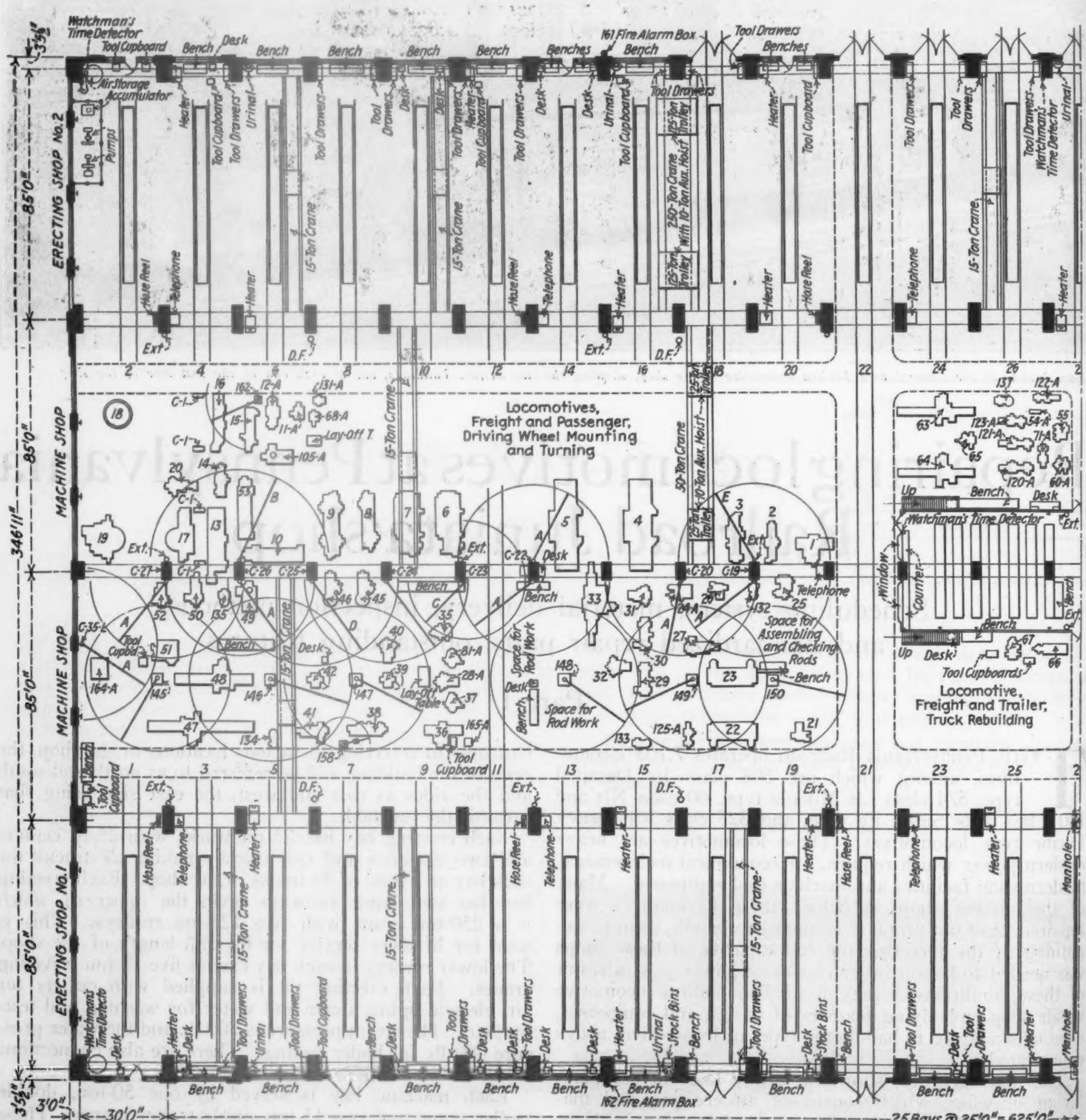
Each erecting bay has 25 pit tracks with 25-ft. centers and two entrance and exit tracks, making 27 tracks for each bay or a total of 54 tracks in the shop. Each erecting bay has two crane runways upon the upper of which is a 250-ton crane with two 125-ton trolleys. This is used for lift-over service for the full length of the shop. The lower runway in each bay carries five 15-ton traveling cranes. Each erecting pit is supplied with outlets for air, electric lights, steam and water for washing and testing, etc. The steam pressure is 300 lb. and the water pressure 400 lb. for boiler testing. There are also connections to the sewer for boiler blow off.

Each machine bay is served by one 50-ton, double trolley crane and two 15-ton single trolley cranes. These bays are well supplied with electrically-operated pillar and jib cranes, there being a total of 35 of these units ranging in capacity from 1,000 lb. to 2,000 lb. They serve the machines on which the heavier work is performed, such as machines for driving boxes, main and side rods, etc.

All the machine tools shown in the accompanying list are motor driven and push-button controlled. The wire conduit is laid in the floor. Practically all of the electrical control apparatus, such as starting rheostats, circuit breakers, etc., is mounted on the center row of the build-

ing columns where they are less liable to injury and do not take up valuable floor space.

The offices of the general foreman, foreman, clerks, etc., are in the second floor of an enclosure 40 ft. by 125 ft., located in the center of the two machine bays. The first floor of this building is taken up by a circulating tool room and storehouse. All small hand or portable tools able reflectors. These lights are located above the cranes and suspended from the roof by disconnecting hangers, which permit the lamps to be electrically disconnected and lowered to the crane platform for the purpose of cleaning without danger of electric shocks to the cleaners. The lamps in each bay section are controlled by a switch located on one of the center columns, enabling each gang




**The north end of the main shop showing the machine tools and shop equipment used for repairing driving boxes, wheels, rods, and bolts and nuts**

are stored, serviced and checked out in this tool room, and small supplies, such as bolts, nuts, etc., for immediate use are kept in the storehouse.

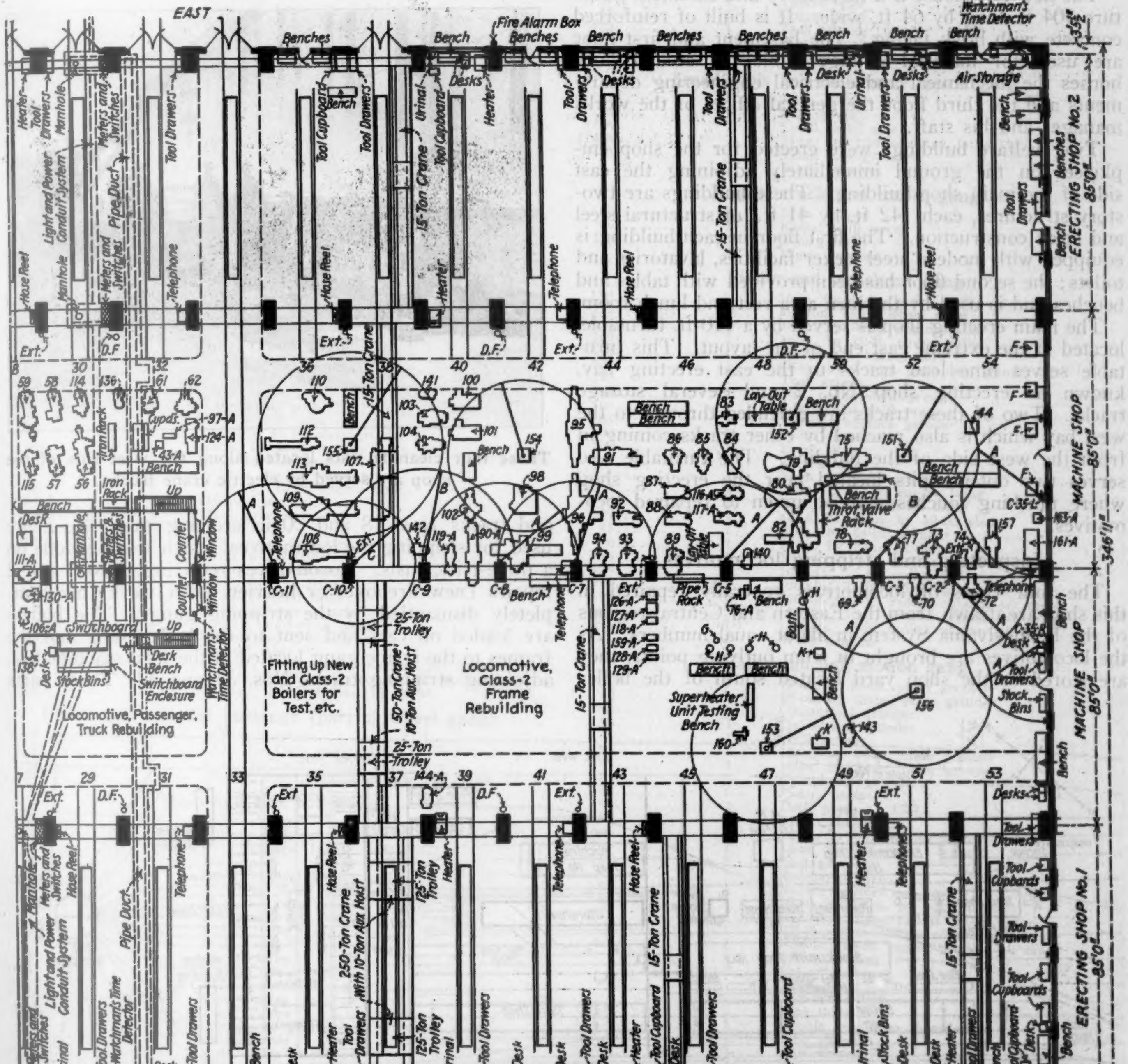
### Method of lighting the shops

The column to column sections of the machine shop bays are each lighted by three 500-watt lamps with suitable to control its individual lighting requirements. In addition, each machine tool is equipped with an individual light for close work such as setting up, measuring, etc.

The two erecting bays are lighted by overhead lamps similar to those in the machine bays. In addition, each side of each track is lighted by two 500-watt lamps located in wide angle reflectors, one of which is located on the

side column between the upper and lower crane runways and one below the lower crane runway. The two lamps on each of the columns are controlled by a switch on the same column.

The lighting of this shop is satisfactory. Owing to the location on the side columns of the lamps in wide angle reflectors, the light from the upper lamps is cast over which is taken up for the storage of heavy locomotive repair parts, for flue rattlers, cleaning vats and other purposes common to erecting shop operations, is lighted by 300-watt flood lights supported on the west wall of the building and similar flood lights on the west crane columns. As a night trick is employed at these shops, it was necessary to provide good lighting so that any class




**The south end of the main shop showing the location of the machine tools used for repairing valves and link motion, pistons and crossheads, ashpans, pipe work and miscellaneous work**

the adjacent locomotive and onto the side of the next locomotive. As a result, the side of each locomotive, especially below the running board, is well lighted. The general lighting in the building is ample at any location to read fine print, blue prints, or make up reports.

The space occupied by the outside crane runway along the west side of the shop adjacent to erecting shop No. 1, of material could be selected or work performed during this trick.

### Construction of new supporting shops

A new flue shop of brick and frame construction, measuring 162 ft. by 45 ft. adjoins the outside craneway near the north end of the main buildnig. The flues are cleaned

in two flue ratters located under the outside crane runway and adjacent to the flue shop. A carpenter shop 151 ft. by 45 ft. is located south of the flue shop. This building is used for repairs to the locomotive cabs and, in addition, for any woodwork which may be necessary on the locomotive and tender, or in the operation of the Juniata shops.

The new storehouse is a three story and basement structure 404 ft. long by 64 ft. wide. It is built of reinforced concrete with brick facing. The basement and first floor are used for material storage while the second floor houses the mechanical and electrical engineering departments and the third floor the general offices of the works manager and his staff.

Two welfare buildings were erected for the shop employees on the ground immediately adjoining the east side of the main shop building. These buildings are two-story structures, each 142 ft. by 41 ft., of structural steel and brick construction. The first floor in each building is equipped with modern steel locker facilities, lavatories and toilets; the second floor has been provided with tables and benches and is used by the men as a rest and lunch room.

The main erecting shop is served by a 110-ft. turntable, located at the extreme east end of the layout. This turntable serves nine lead tracks to the east erecting bay, known as erecting shop No. 2 and several storage tracks. Two of these tracks are extended through to the west bay which is also reached by other tracks coming in from the west side of the building. The turntable also serves two outside pits located near the erecting shop where finishing touches may be given to repaired locomotives.

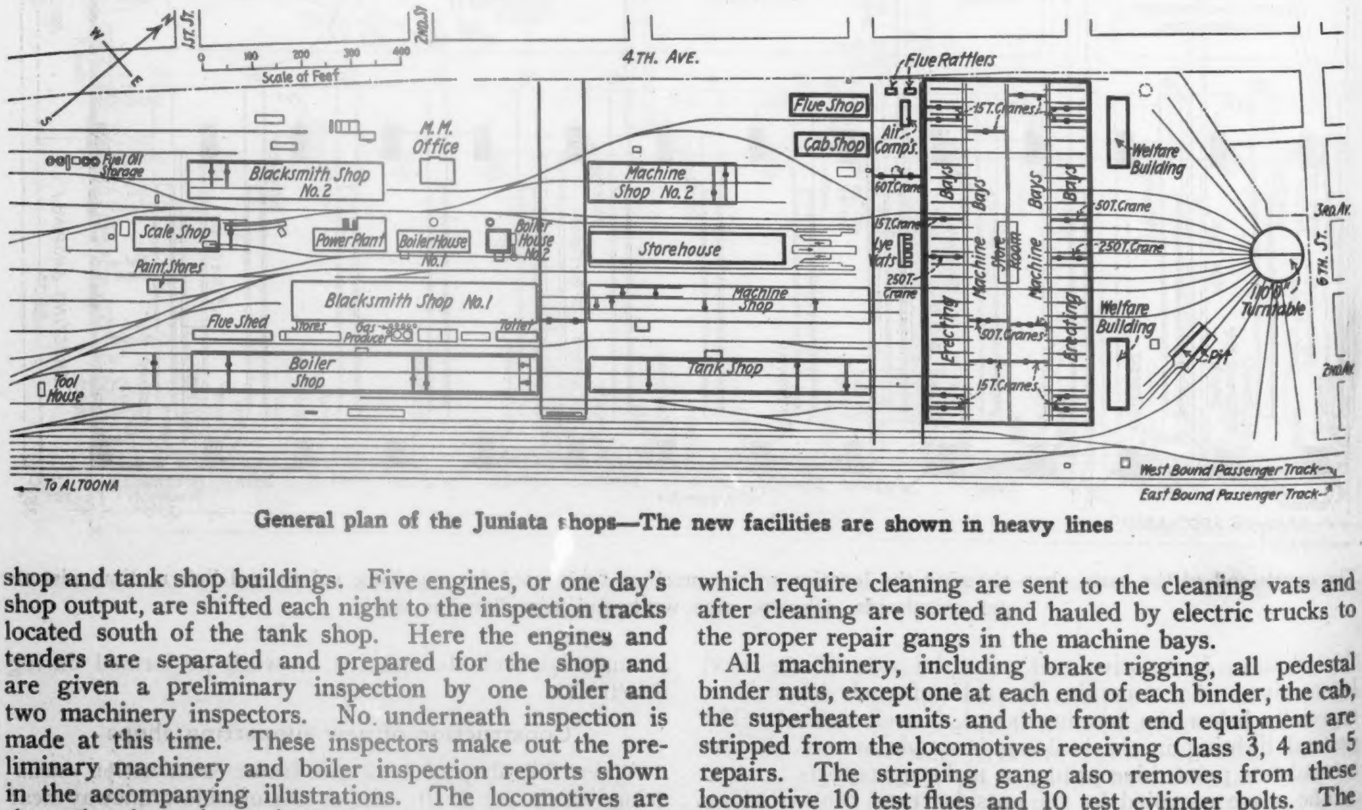
### Inspecting and stripping locomotives

The four types of locomotives generally repaired in this shop are drawn from the Eastern and Central regions of the Pennsylvania System in about equal numbers. As the locomotives are brought in from outlying points, they are stored in the shop yard located south of the boiler turntable. About three days' supply of locomotives are generally kept on these tracks to eliminate any possibility of having a repair track waiting for a locomotive and to allow the scheduling department ample time to analyze the inspectors' reports and order any material required for unusual repair jobs.

Erecting tracks Nos. 35 and 37 in erecting shop No. 1

**These four cleaning vats located along the west side of the shop are served by electric crane trucks**

and tracks Nos. 18 and 20 in erecting shop No. 2 are used for stripping the locomotives, which work is done on a three-trick basis. Locomotives receiving Class 1 and 2 repairs (new fireboxes or heavier boiler work) are completely dismantled by the stripping gangs. The boilers are loaded on cars and sent to the boiler shop and the frames to the frame gang located in the west machine bay, adjoining stripping tracks Nos. 35 and 37. Those parts




**General plan of the Juniata shops—The new facilities are shown in heavy lines**

shop and tank shop buildings. Five engines, or one day's shop output, are shifted each night to the inspection tracks located south of the tank shop. Here the engines and tenders are separated and prepared for the shop and are given a preliminary inspection by one boiler and two machinery inspectors. No underneath inspection is made at this time. These inspectors make out the preliminary machinery and boiler inspection reports shown in the accompanying illustrations. The locomotives are then placed on the various storage tracks served by the which require cleaning are sent to the cleaning vats and after cleaning are sorted and hauled by electric trucks to the proper repair gangs in the machine bays.

All machinery, including brake rigging, all pedestal binder nuts, except one at each end of each binder, the cab, the superheater units and the front end equipment are stripped from the locomotives receiving Class 3, 4 and 5 repairs. The stripping gang also removes from these locomotive 10 test flues and 10 test cylinder bolts. The conditions indicated by these test parts help to determine

# Machine tools installed at the Pennsylvania Juniata locomotive repair shop classified according to the repair gang in which they are located

### Driving box gang

| Drawing reference | Number | Description of machines |
|---|---|---|
| 38 | 1 | 30-in. by 11-ft. 6-in. engine lathe |
| 41 | 1 | 18-in. slotter |
| 134 | 1 | Tool grinder |
| 47 | 1 | 48-in. by 48-in. by 16-ft. planer |
| 164-A | 1 | 44-in. by 60-in. driving box babbitting furnace |
| 51 | 1 | 42-in. vertical turret lathe |
| 52 | 1 | Drill press |
| 50 | 1 | 18-in. slotter |
| 135 | 1 | Tool grinder |
| 49 | 1 | 5-ft. radial drill press |
| 45 | 1 | 54-in. driving box boring mill |
| 46 | 1 | 54-in. driving box boring mill |
| 40 | 1 | Drill press |
| 39 | 1 | 100-ton press |
| 42 | 1 | 100-ton press |
| 48 | 1 | 48-in. by 48-in. by 12-ft. planer |
| c-35-L | 1 | 1000-lb., 25-ft. radius column jib crane |
| c-27 | 1 | 1000-lb., 25-ft. radius column jib crane |
| c-26 | 1 | 1000-lb., 25-ft. radius column jib crane |
| c-25 | 1 | 1000-lb., 28-ft. radius column jib crane |
| c-24 | 1 | 1000-lb., 28-ft. radius column jib crane |
| c-23 | 1 | 1000-lb., 20-ft. radius column jib crane |
| 145 | 1 | 1000-lb., 25-ft. radius pillar crane |
| 146 | 1 | 1000-lb., 28-ft. radius pillar crane |
| 147 | 1 | 1000-lb., 25-ft. radius pillar crane |
| | 2 | Work benches |
| | 1 | Layoff table |

### Wheel repair gang

| | | |
|---|---|---|
| 18 | 1 | Tire heating furnace |
| 19 | 1 | 100-in. tire mill |
| 20 | 1 | 22-in. slotter |
| 17 | 1 | 7-ft. boring mill |
| 16 | 1 | Heavy axle lathe |
| 13 | 1 | 20-in. by 10-ft. plain grinder |
| 14 | 1 | 23-in. by 10-ft. engine lathe |
| 15 | 1 | Axle keyseating machine |
| 53 | 1 | 600-ton, 96-in. wheel press |
| 12-A | 1 | 23-in. by 10-ft. engine lathe |
| 11-A | 1 | Milling machine |
| 131-A | 1 | Tool grinder |
| 68-A | 1 | 16-in. shaper |
| 105-A | 1 | 5-ft. radial drill press |
| 4 | 1 | 90-in. wheel lathe |
| 5 | 1 | 90-in. wheel lathe |
| 6 | 1 | 90-in. journal lathe |
| 7 | 1 | 90-in. journal lathe |
| 8 | 1 | 90-in. quartering lathe |
| 9 | 1 | 100-in. quartering lathe |
| 10 | 1 | 600-ton, 96-in. wheel press |
| | 1 | Lay-off table |
| c-27 | 1 | 1000-lb., 25-ft. radius column jib crane |
| c-26 | 1 | 1000-lb., 30-ft. radius column jib crane |
| 162 | 1 | 4000-lb., 25-ft. radius, air hoist |

### Piston and cylinder bushings (part of wheel gang)

| | | |
|---|---|---|
| 1 | 1 | Milling machine |
| 2 | 1 | 23-in. by 12-ft. engine lathe |
| 3 | 1 | 42-in. by 14-ft. engine lathe |
| c-19 | 1 | 1000-lb., 25-ft. radius, column jib crane |

### Main and side rod gang

| | | |
|---|---|---|
| 35 | 1 | 24-in. shaper |
| 36 | 1 | Milling machine |
| 37 | 1 | 36-in. vertical boring mill |
| 28-A | 1 | Drill press |
| 81-A | 1 | 36-in. vertical boring mill |
| 165-A | 1 | 24-in. by 30-in. brazing furnace |
| 33 | 1 | 22-in. by 84-in. surface grinder |
| 31 | 1 | Drill press |
| 30 | 1 | Turret lathe |
| 32 | 1 | Drill press |
| 29 | 1 | Turret lathe |
| 133 | 1 | Tool grinder |
| 24-A | 1 | Plain grinder |
| 26 | 1 | 75-ton press |
| 132 | 1 | Tool grinder |
| 25 | 1 | Cylindrical grinder |
| 27 | 1 | 18-in. slotter |
| 23 | 1 | Rod boring machine |
| 125-A | 1 | 16-in. by 8-ft. engine lathe |
| 22 | 1 | Rod boring machine |
| 21 | 1 | 75-ton press |
| 148 | 1 | 1000-lb., 25-ft. radius pillar crane |
| 149 | 1 | 1000-lb., 25-ft. radius pillar crane |
| 150 | 1 | 1000-lb., 25-ft. radius pillar crane |
| c-19 | 1 | 1000-lb., 25-ft. radius column jib crane |
| c-20 | 1 | 1000-lb., 25-ft. radius column jib crane |
| c-22 | 1 | 1000-lb., 25-ft. radius column jib crane |
| | 3 | Work benches |

### Brass and bolt gang

| | | |
|---|---|---|
| 63 | 1 | 36-in. by 36-in. by 12-ft. planer |
| 64 | 1 | 36-in. by 36-in. by 12-ft. planer |
| 65 | 1 | Drill press |
| 120-A | 1 | 16-in. by 10-ft. engine lathe |
| 121-A | 1 | 16-in. by 10-ft. engine lathe |
| 123-A | 1 | 16-in. by 8-ft. engine lathe |
| 137 | 1 | Tool grinder |
| 122-A | 1 | 16-in. by 8-ft. engine lathe |
| 54-A | 1 | Small bolt centering machine |
| 55 | 1 | Triple head bolt threader |
| 71-A | 1 | Turret lathe |
| 60-A | 1 | Bolt altering machine |

A—These machines are bolted permanently to the floor but are not set on concrete foundations as are the others.

| Drawing reference | Number | Description of Machine |
|---|---|---|
| 58 | 1 | Turret lathe |
| 59 | 1 | Turret lathe |
| 114 | 1 | Turret lathe |
| 115 | 1 | Turret lathe |
| 57 | 1 | Turret lathe |
| 56 | 1 | Turret lathe |
| 136 | 1 | Tool grinder |
| | 2 | Work benches |
| | 2 | Iron racks |

### Small tools and machinery repair gang

| | | |
|---|---|---|
| 61 | 1 | 24-in. shaper |
| 62 | 1 | Drill press |
| 97-A | 1 | Small metal saw |
| 124-A | 1 | 24-in. by 10-ft. engine lathe |
| 43-A | 1 | Small tool grinder |
| | 2 | Work benches |

### Engine truck and trailer gang

| | | |
|---|---|---|
| 67 | 1 | 24-in. shaper |
| 66 | 1 | Radial drill press |
| 138 | 1 | Tool grinder |
| | 2 | Work benches |

### Piston and crosshead gang

| | | |
|---|---|---|
| 110 | 1 | 36-in. by 44-in. boring mill |
| 112 | 1 | 400-ton, 48-in. wheel press |
| 113 | 1 | 36-in. by 20-ft. engine lathe |
| 109 | 1 | 36-in. by 20-ft. engine lathe |
| 108 | 1 | Horizontal boring mill |
| 107 | 1 | 20-in. by 144-in. plain gap grinder |
| 141 | 1 | Tool grinder |
| 100 | 1 | 5-ft. radial drill press |
| 101 | 1 | 5-ft. radial drill press |
| 103 | 1 | Vertical surface grinder |
| 104 | 1 | 24-in. shaper |
| 102 | 1 | 15-in. slotter |
| 142 | 1 | Tool grinder |
| 119-A | 1 | 16-in. by 8-ft. engine lathe |
| 90-A | 1 | 23-in. by 14-ft. engine lathe |
| 98 | 1 | 42-in. vertical turret lathe |
| 99 | 1 | 48-in. by 48-in. by 10-ft. planer |
| 95 | 1 | 22-in. by 84-in. grinder |
| 96 | 1 | 22-in. by 84-in. grinder |
| 155 | 1 | 1000-lb., 30-ft. radius pillar crane |
| 154 | 1 | 1000-lb., 25-ft. radius pillar crane |
| c-11 | 1 | 1000-lb., 25-ft. radius column jib crane |
| c-10 | 1 | 1000-lb., 20-ft. radius column jib crane |
| c-9 | 1 | 1000-lb., 30-ft. radius column jib crane |
| c-8 | 1 | 1000-lb., 25-ft. radius column jib crane |
| | 2 | Work benches |

### Valve and link motion gang

| | | |
|---|---|---|
| 91 | 1 | 12-in, by 96-in. plain grinder |
| 92 | 1 | 10-in. by 24-in. plain grinder |
| 93 | 1 | Cylindrical grinder |
| 94 | 1 | Cylindrical grinder |
| 86 | 1 | Drill press |
| 87 | 1 | 10-in. by 24-in. plain grinder |
| 88 | 1 | 10-in. by 24-in. plain grinder |
| 89 | 1 | Cylindrical grinder |
| 83 | 1 | 75-ton press |
| 84 | 1 | Drill press |
| 85 | 1 | 24-in. shaper |
| 116-A | 1 | 16-in. by 8-ft. engine lathe |
| 117-A | 1 | 16-in. by 8-ft. engine lathe |
| 140 | 1 | Tool grinder |
| 79 | 1 | Radius grinder |
| 80 | 1 | Radius grinder |
| 82 | 1 | 36-in. by 36-in. by 8-ft. planer |
| 152 | 1 | 1000-lb., 25-ft., radius pillar crane |
| c-7 | 1 | 100-lb., 28-ft. radius column jib crane |
| c-5 | 1 | 1000-lb., 25-ft. radius column jib crane |
| | 2 | Work benches |
| | 2 | Lay-off tables |

### Pipe gang

| | | |
|---|---|---|
| 126-A | 1 | Pipe threader |
| 127-A | 1 | Double head pipe threader |
| 118-A | 1 | Pipe threader |
| 159-A | 1 | Pipe threader |
| 128-A | 1 | Pipe cutting machine |
| 129-A | 1 | Pipe burr removing machine |
| 76-A | 1 | Copper pipe saw |
| 160 | 1 | Superheater unit testing valves and stand |
| 153 | 1 | 1000-lb., 25-ft. radius pillar crane |
| H | 5 | 24-in. diameter pipe bender furnaces |
| K | 2 | 24-in. by 36-in. pipe bender's furnaces |
| G | 1 | 22-in. diameter pipe bender's furnace |
| | 4 | Work benches |
| | 1 | Superheater unit testing bench |
| | 1 | Pipe rack |

### Miscellaneous gang

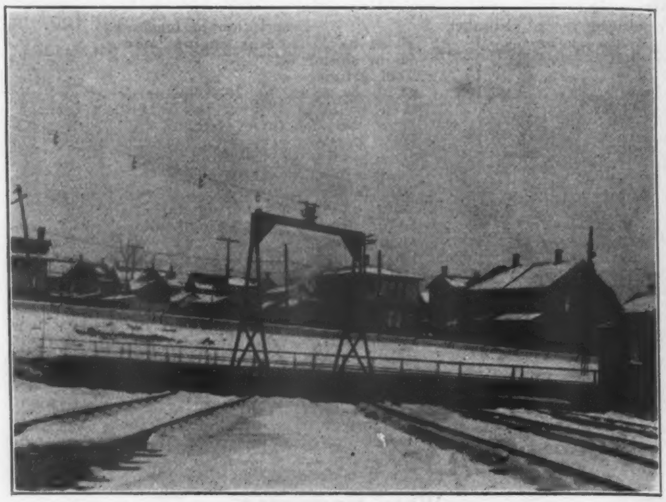
| | | |
|---|---|---|
| 75 | 1 | Horizontal boring mill |
| 78 | 1 | Radial drill press |
| 77 | 1 | Drill press |
| 74 | 1 | Slotter |
| 73 | 1 | 18-in. traveling head slotter |
| 157 | 1 | Stock adjusting machine |
| 161-A | 1 | 13½-in. by 44-in. pedestal cap furnace |
| 163-A | 1 | 18-in. by 30-in. annealing furnace |
| 44 | 1 | Belt driven hammer |
| 151 | 1 | 1000-lb., 25-ft. radius pillar crane |
| c-3 | 1 | 1000-lb., 30-ft. radius column jib crane |
| c-35-2 | 1 | 1000-lb., 25-ft. radius column jib crane |
| F | 4 | 42-in. by 42-in. blacksmith forges |
| | 4 | Work benches |
| | 2 | Throttle valve racks |

| Drawing reference | Number | Description of Machine |
|---|---|---|
| **Ash pan gang** | | |
| 69........ | 1 | 36-in. shear |
| 70........ | 1 | 36-in. punch |
| 72........ | 1 | Drill press |
| 143........ | 1 | Tool grinder |
| 156........ | 1 | 1000-lb., 30-ft. radius pillar crane |
| c-3........ | 1 | 1000-lb., 36-ft. radius pillar crane |
| c-2........ | 1 | 1000-lb., 25-ft. radius pillar crane |
| c-35-R........ | 1 | 1000-lb., 25-ft. radius pillar crane |
| | 2 | Work benches |
| **Machine and tool room** | | |
| 111-A...... | 1 | Tool grinder |
| 130-A...... | 1 | Tool grinder |
| 106-A...... | 1 | Drill grinder |
| | 1 | Work bench |
| **Frame gang** | | |
| 144-A...... | 1 | Tool grinder |

the amount of repair work necessary. When removal of the flues is necessary, this work is done on the repair track, after which the flues are taken to the flue rattler and cleaned, and then to the flue shop for safe ending and testing, which is supervised by a gang foreman who reports to the erecting shop boiler foreman.

The lagging, spring rigging and flues are not removed as this work is done on the repair track, depending on the nature of the repairs required. After the locomotives to receive Class 3, 4 and 5 repairs are stripped this far, they are moved outside of the shop, if the designated repair track is not empty, where about six or eight of them are usually kept in storage. When needed they are placed on the entrance or exit track pits where they are unwheeled in about one hour, after which they are placed on the repair tracks ready for rebuilding.

The parts requiring cleaning are sent to the four 10-ft. by 15-ft. by 5-ft. steel-lined concrete cleaning vats located outside of erecting shop No. 1. Four perforated steam pipes are located on the bottom of each vat for the purpose of heating and agitating the cleaner. Each vat requires an initial mixture of 1,300 lb. of flake caustic soda and 500 gal. of water, to which 325 lb. of soda is added weekly. The vats are cleaned out every three months.



**This 110 ft. turntable serves nine lead-in tracks to the repair shop**

JUNIATA SHOPS — Sheet No.1
Preliminary Inspection Report - Machinery

Loco. No. .........Class.......Divn.............Class Reprs.......Date Rec'd.......

Pilot____ Coupler____
Bumper Castgs. R.____ C.____ L.____
Center Castgs. Under Cyl.____
CYLINDER AND SADDLE:
R. Is Cyl. Working____
Are Bolts O.K.____
L. Is Cyl. Working____
Are Bolts O.K.____
Guides R.____ L.____
Crosshead R.____ L.____
Guide Yoke R.____ L.____
Lift Shaft____
Link Brkt. Suppt. R.____ L.____
Link Bracket R.____ L.____
EXPANSION SHEETS:
#1 Top R.____ L.____ Bottom R.____ L.____
#2 " "
#3 " "
#4 " "
#5 " "
#6 " "
FRAME STIFF CASTINGS:
#1 R.____ L.____
#2 R.____ L.____
#3 R.____ L.____
#4 R.____ L.____
SPRING EQUAL. SEAT ON FRAME:
#1 R.____ L.____
#2 R.____ L.____
#3 R.____ L.____
#4 R.____ L.____
LATERAL FRAME BRACE:
#1____
#2____
#3____
Boiler Suppt. at Mud Bar R.____ L.____
Foot Plate Casting____
Cab Bracket R.____ L.____
Smoke Box Frt. End Ring____ Door____
Air Res. Brkts. on Frt. End____
Running Boards R.____ L.____
Stack____ Bell____
Sand Box____ Whistle____
Safety Valves____
Hand Rail over Smoke Box____
Hand Rail on Boiler R.____ L.____
Superht. Damper Cyl.____
Dome Cap & Studs____

RUNNING BOARD BRACKETS:
R. #1____ L. #1____
R. #2____ L. #2____
R. #3____ L. #3____
R. #4____ L. #4____
Running Board Brkt. Studs R.____ L.____
Air Res. Brkts. R.____ L.____
Air Res. Brkt. Studs R.____ L.____
Power Reverse Gear____
Power Gear Bracket____
Power Gear Brkt. Studs____
Air Pump____
Air Pump Bracket____
Air Pump Brk. Studs____
Feed Water Pump____
Feed Water Pump Brkt.____
Feed Water Pump Brkt. Studs____
VALVE GEAR:
Link Trunnion Bushgs. R.____ L.____
Link R.____ L.____
Link Block R.____ L.____
Eccentric Crank R.____ L.____
Eccentric Rods R.____ L.____
Radius Rods R.____ L.____
Connecting Links R.____ L.____
Lamp & Lead Levers R.____ L.____
Valve Stem Xhds. R.____ L.____
Back Valve Chb. Hds. R.____ L.____
Front Valve Chb. Hds. R.____ L.____
Piston Rrt. Guide R.____ L.____
Piston Rrt. Guide Cov. R.____ L.____
JACKET:
Bands____
Barrell____
Fire Box Inside Cab____
Outside Cab____
Fire Door Frame____ Fire Door____
Cab____
Glass Water Gauge____
Steam & Air Gauges____
Throttle Lever____
Blower Rigging____
Cocks & Valves____
Inj. Opr. Rigging____
Lubricator____
Main Rods R.____ L.____
Side Rods R.____ L.____

Sheet No. 2

FRAMES:
Main R.____ L.____
Front R.____ L.____
Rear R.____ L.____

REMARKS:____

| DRIVING BOX LATERAL | | TIRE THICKNESS | | TIRE WEAR | |
|---|---|---|---|---|---|
| R.1 | L.1 | R.1 | L.1 | R.1 | L.1 |
| R.2 | L.2 | R.2 | L.2 | R.2 | L.2 |
| R.3 | L.3 | R.3 | L.3 | R.3 | L.3 |
| R.4 | L.4 | R.4 | L.4 | R.4 | L.4 |
| R.5 | L.5 | R.5 | L.5 | R.5 | L.5 |

TIRES: Turn____ Renew____

| DRIVING BOX JOURNAL FIT | | ENGINE TRUCK LATERAL | |
|---|---|---|---|
| R.1 | L.1 | R.1 | L.1 |
| R.2 | L.2 | R.2 | L.2 |
| R.3 | L.3 | | |
| R.4 | L.4 | TRAILER TRUCK LATERAL | |
| R.5 | L.5 | R. | L. |

Broken or Missing Locomotive and Tender Parts

Date Inspected____ Inspector____

**This detail report is filled out by the machinery inspectors when they examine a locomotive received at shop for repairs**

The parts are here loaded in perforated steel boxes as shown in one of the illustrations. All the lifting is done by crane type electric trucks except placing the steel boxes

in vats which is done by the overhead crane. There are several sizes of boxes designed to fit and fill the vats in connection with each other, the medium size, being designed to hold 10 driving boxes and 10 pedestal binders, all from a Decapod locomotive. The parts remain in

General view of the east machine bay showing a part of the wheel gang

the bath about 2 hr., after which they are removed, rinsed in warm water and then distributed for repairs.

### Shop organization

About 1,950 men are employed in this shop under the direct supervision of a general foreman. Each erecting bay consisting of 27 tracks (23 of which are used for erecting work) is supervised by an erecting foreman. Each daylight erecting foreman has under his jurisdiction five track gangs, two pipe gangs, two steam pipe gangs and one valve motion and brake rigging gang, each supervised by a gang foreman. The night foreman who is the stripping foreman has charge of two track gangs, one pipe gang and one steam pipe gang in each erecting shop in addition to his stripping organization, which completes out-going locomotives and work on those receiving extra heavy repairs.

Each erecting bay has a daylight assistant boiler foreman who reports to the boiler shop foreman. Each of these two men has charge of a flue gang, two boiler repair gangs and two ash-pan gangs on the daylight force and one flue gang, two boiler repair gangs and two ash-pan gangs on nights who report to the day organization and are handled by the stripping foreman. The boiler repair gangs make all repairs to the boilers in the shop, give boilers special staybolt examination, apply all patches, sheets and bolts necessary to remove and reset the flues. They also cut out and apply flues to all Class 1 and 2 repair locomotives. They also remove and replace cabs, running boards, front end arrangement, and ash-pans.

When a Class 1 or 2 repair boiler comes from the boiler shop, the boiler trimming gang in the machine bay applies all boiler fittings and finishes the boiler ready for testing. The usual procedure is to test and steam the boiler and apply the lagging and jacket before it is put on the frame.

The stripping foreman dismantles all the locomotives and his inspectors cover the locomotive machinery and pipe parts as dismantled and authorize all the repair work. The boiler is not given its final inspection until it is placed either on the erecting track or in the boiler shop.

Other foremen, reporting directly to the general foreman, are the tank shop foreman, the carpenter shop foreman, three machine shop foremen, a piece-work foreman and a schedule foreman.

There are piece-work inspectors reporting to a piece-work foreman who approves the finished work and authorizes the payment designed on the piece-work charts. The piece-work foreman handles all questions pertaining to piece-work prices, etc.

Of equal importance is the schedule foreman whose inspectors examine the locomotive when received at the shop and from whose reports the general repairs and schedule time is determined. From this basis the schedule times for the parts to be returned to the locomotive and operations to be completed are set as well as the date the locomotive is to go out of the shop. The schedule foreman also controls the cleaning and delivery of all materials from the cleaning vats and storehouse.

### How the schedule department functions

The schedule foreman has under him a boiler and two machinery inspectors whose duties are to inspect the loco-

**Machine Shop Repair Items**

| Description | From E.S. Due | From E.S. Del. | To E.S. Due | To E.S. Del. | Remarks |
|---|---|---|---|---|---|
| Crossheads | | | | | |
| Pistons | | | | | |
| Guides | | | | | |
| Driv. Boxes | | | | | |
| Wheels, Cranks | | | | | |
| Main Rods | | | | | |
| Side Rods | | | | | |
| Trailer Truck | | | | | |
| Engine Truck | | | | | |
| Piston Packing | | | | | |
| Cocks & Valves | | | | | |
| Power Reverse | | | | | |
| Screw Reverse | | | | | |
| Reverse Lever | | | | | |
| Feed Water Pump | | | | | |
| Stoker | | | | | |
| Throttle Rigging | | | | | |
| Spring " | | | | | |
| Brake " | | | | | |
| Link Motion | | | | | |
| Eccen. Rods | | | | | |
| Piston Valves | | | | | |
| Chamber Heads | | | | | |
| Throttle Lever | | | | | |
| Reach Rods | | | | | |
| Lift Shaft | | | | | |
| Link Brackets | | | | | |

**Erecting & Boiler Shop Repair Operations**

| Operation | Due | Comp. | Remarks |
|---|---|---|---|
| Stripped & Work Dist. | | | |
| Loco. placed on Rep.Trk. | | | |
| Flues out | | | |
| Flues in | | | |
| Flue Work completed | | | |
| Boiler washed | | | |
| Boiler work comp. | | | |
| Frames & Cyl. work comp. | | | |
| Caps & Spring Rigging up | | | |
| Lift Shaft erected | | | |
| Shoes & Wedges layed out | | | |
| Loco. Wheeled & Trammed | | | |
| Guide Pist. & X-Hd. erec. | | | |
| Rods erected | | | |
| Stokers on | | | |
| Valve & Link Motion erec. | | | |
| Valves set | | | |
| Boiler closed & tested | | | |
| Units in & tested | | | |
| Ash Pans up, Grates in | | | |
| Cab on | | | |
| Lagging & Jacket on | | | |
| Pipe work completed | | | |

Remarks____

Loco. No.____ Class____ Repairs____ In Shop____
Scheduled out____ Completed____ Bay No.____ Trk. No.____

This form is filled out by the schedule foreman and the information is posted on the shop schedule boards for each supervisor in the shop

motive when received at the shops. These inspectors make a record on a form of every part inspected. In addition, when the locomotives are being stripped and after the locomotives are placed on the repair tracks, the stripping foreman and track gang foreman make an inspection and report to the schedule foreman any unusual conditions or exceptionally heavy work which was not included on the original inspector's report. After this information is assembled the scheduling department determines the time required to repair each part and the time at which each locomotive is to leave the shop. This information is filled in on the blank form shown in one of the illustrations, and the information given to each repair gang foreman by placing it on his schedule board. It is also entered on a master schedule board located in the schedule foreman's office. The list of parts on this board is arranged in the same way as that on the foreman's forms, with enough vertical columns to take care of one month's output.

As the locomotives are rebuilt, the schedule foreman closely follows the time schedules and sees that the parts are delivered to the repair tracks on time. He considers time only and does not pass on the quality of workmanship, this being the function of the gang foreman and piece-work inspectors. As each part is repaired and placed on the locomotive, the gang foreman first examines the work, after which the piece-work inspector finally passes it. If it meets with his approval he O.K.'s the piece-work charges and authorizes payment to the men for the work which they have performed.

Another function of the scheduling department is to order all materials and have it delivered to the repair tracks, the machine bay repair gangs or the working and stock bins. Twenty telephone booths, located in the erecting and machine bays are connected with a switchboard located in the schedule foreman's office. As each gang foreman needs material he calls up the office, tells what material he wants, how it is to be charged and where it is to be delivered. This information is put on a material order slip which is taken at 20-min. intervals by a messenger to a labor leader located at the main storehouse. There are three labor gangs under the schedule foreman, each handling a certain line of material. The orders are then filled and delivered by electric trucks to the designated points. All repaired parts are delivered to the pit tracks by the repair sections. The purpose of this system is to keep the repairmen busy and not waste time going after new or repaired parts.

Material bins are conveniently located about the shop. In these are kept about 2,500 different small parts. The schedule foreman assigns a labor gang with electric trucks to keep these bins filled. This gang devotes all of its time to watching the bins, drawing the material from the main storehouse and properly piling it in the bins. Each month's material charges are distributed over the number of locomotives turned out during the month.

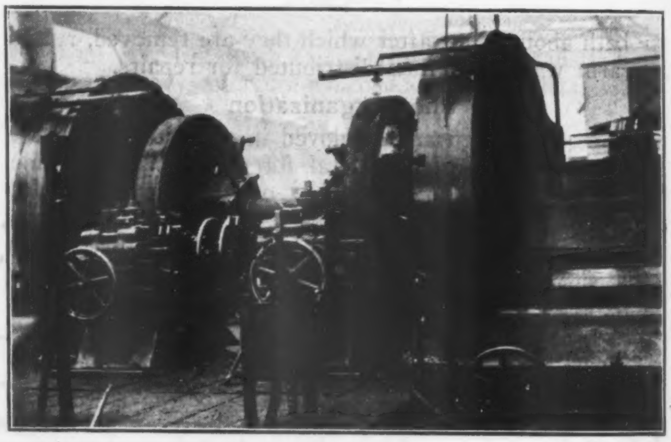
The reclamation of scrap also comes under the supervision of the schedule foreman. All the scrap material is hauled out to the scrap platform located at the east end of the storehouse. Here it is inspected by one man who passes on every piece and picks out what he thinks can be reclaimed and the remainder is thrown into the scrap car. He also routes it to the proper shop for any reclamation work necessary.

### Organization of the machine bays

The two machine bays are supervised by three foremen. Starting at the north end of the machine bays, the first foreman has charge of wheel, box, rod and truck repairs. The foreman in the middle of the machine bays has charge of the repairs to pistons, crossheads and guides, valve and link motion work, brass and bolt work, brake and spring rigging and miscellaneous work. The third foreman at the south end of the shop has charge of Class 1 and 2 boiler repairs, repairing frames, superheater units, pipe, ash pans, welding and cutting work and the tool-room and machinery repair work.

### Standardizing repair parts

The Pennsylvania Railroad for many years has been working towards the standardization of repair parts for locomotives. As a result, practically all new parts, such as crank and knuckle pins and bushings, valve motion parts, piston valves and bushings, shoes and wedges and similar parts are semi-finished in other departments. This practice reduces the work in the two machine bays to a minimum. As an illustration, all valve motion pins and bushings are blanked out to establish step sizes on automatic screw machines and then case-hardened in the automatic shop which is a unit of the Altoona machine shops. The bore of the bushings and the body or bearing surface of the pins are ground to gage sizes by quantity production methods. Therefore, it is only necessary when fitting these parts to the locomotives, to grind the outside of the bushing and the two tapered ends of the pins. Suitable gages and micrometers are provided which reduce



**One of the large wheel lathes—Note that the driving boxes are on the pair of wheels in the lathe**

the time of fitting to a minimum. Practically the same methods are followed for side rod knuckle pins and bushings, crank pins, etc. The result of supplying these semi-finished parts to the new shops is reflected in the number of machine tools installed in the new machine shop bays which is smaller per locomotive repaired than in the general average of locomotive repair shops.

As one passes through the machine bays there is a noticeable absence of filing operations. This is made possible by the liberal use of plain, cylindrical, internal and surface grinders, milling and other machines, some of which have been fitted up for one particular operation. The experience at Altoona has shown the economy of assigning a machine to a single specified job and fitting that machine with all possible labor saving devices wherever a sufficient volume of work is available.

One also soon becomes aware of the fact that the machine operators rarely leave their machines to take measurements, a condition that has been brought about by the liberal use of micrometer calipers and size blanks. The use of accurate measuring devices has made it practicable for the inspectors to measure and set down on specially prepared blanks* the dimensions to which the

*There are nine of these dimension blanks, four of which are used to illustrate the article. The other five show cylinder and valve chamber sizes, pedestal cap sizes, piston rod and crosshead pin sizes, guide and crosshead sizes and a report on side rod brasses.

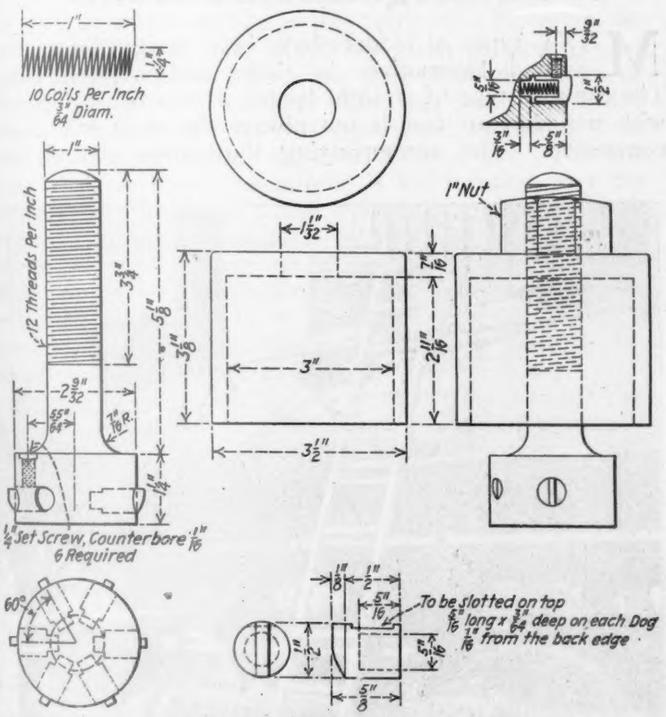
new or repaired parts are to be finished, allowance being made by the inspectors for the fit.

Another outstanding feature of the work in the machine shop is the extent to which special gages, fixtures, jigs, etc., are used to speed up the work.

(*To be concluded next month*)

# Air pump bushing puller

In the top head of an 8½-in. cross-compound air pump is located a small bushing having six ports or openings. In dismounting these pumps for overhauling, it has been found quite a difficult job to remove this bushing without actually destroying it. While in many cases the bushing is not used again, nevertheless, to remove it either by boring out or chipping out involves a great amount of time. As a means of conveniently removing this bushing, the puller illustrated in the drawing accompanying this article will, no doubt, be of interest to mechanics engaged in overhauling these pumps. The bushing puller consists




**Device for removing the bushing from the top head of 8½-in. cross-compound air compressors**

essentially of three parts. The body of the puller, as may be seen, is similar in appearance to a plug gage, in the large section of which are located six dogs or latches set into the body in such a manner that, as the body of the puller is inserted in a bushing, these latches are forced back into their respective recesses against the pressure of individual springs. The upper portion, or spindle, of the puller body is threaded to take a nut of suitable size. The third part of the puller assembly consists of a cup washer so designed that the inside diameter and the depth of the cup are each slightly greater than the outside diameter and length of the bushing to be removed. In using this device, the body of the puller is inserted in the bushing and not greater than a one-sixth turn is given so that the six individual dogs or latches will spring out in the ports or slots in the bushing. The cup washer is placed over the spindle and rests on the body of the pump head. The nut is then turned down with a wrench and the latches, engaged in the openings in the bushing, pull it out into the cup portion of the washer.

# Gage for quartering and checking driving wheels

*By W. C. Deibert*

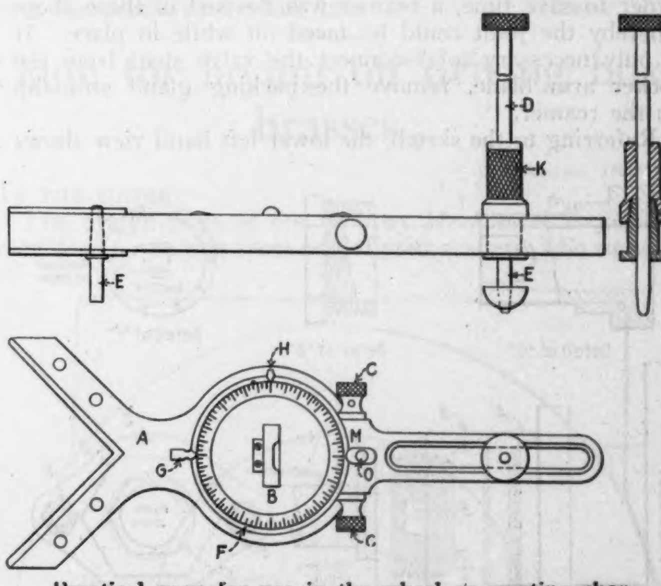
*Toolroom foreman, C. & O., Clifton Forge, Va.*

When a locomotive comes in the repair shop, one of the imperative jobs pertaining to wheel repairs is to check them carefully in order to determine whether or not the crank pin is in the proper location so that the valve motion events occur at the proper intervals. A quartering gage is the instrument commonly used for this work. The one shown in the illustration, because of its unique design, is well adapted for this class of work.

It consists of an aluminum body *A* and a dial *B* which is graduated to 90 deg. from either side. The dial is revolved by means of a worm gear which is operated by the knurled headed screws *C*. The vee-end of the gage is faced with hardened steel plates, while the slotted end is fitted with a steel bushing. The adjustable ball center *D* is long enough to reach the center of the axle even though it has entered a short distance in the wheel. The ball center *D* is locked in position by the knurled handle *K*. The two indicators *H* and *G* on the frame *A* are spaced 90 deg. apart. The dial *F* can be revolved to any desired position, and then locked by the clamp *M*. The two pins *E* are used to steady the gage and also to center the gage in the crank pin hole.

There are two methods of using this gage. The first is by the usual method of squaring up the wheels. The second is to quarter a pair of wheels regardless of where the pins are located.

When using the gage for the first method, the zero




**Practical gage for use in the wheel or erecting shop**

mark on the dial is set to the pointer *G*. The vee of the gage is placed on the crank pin with the pins *E* against the hub of the wheel, after which the ball center *D* is adjusted to the center of the axle. Then, by means of a block and wedge, the wheel is moved until the gage is level. All that is necessary now to place the gage in position for the other wheel is to raise the knurled knob *C* which lifts the worm free of the gear, and then move the dial *B* a quarter turn, and lock it in this position. As the gage is now set for the other wheel, place it on the wheel to be pressed on the axle and move it until the gage shows level and then press the wheel on.

With the second method, it is not necessary to square

up the wheels as they can be quartered with the crank pins in any position. The gage is placed on the wheel as before and the dial turned until level and the reading noted. If the reading, for example, should be 30 deg., the dial is moved back to the same reading on the opposite side of the zero mark and the reading taken at the point $H$. This reading is then moved back to the pointer $G$ and is set for the other quarter. The gage is placed on the wheel to be pressed on the axle and moved until the gage shows level, which indicates that the wheel is ready to be pressed on. If the reading should be in a fraction of a degree, before moving the dial, the clamp $M$ should be loosened and the ring $F$ moved until the pointer $H$ coincides with the first degree mark nearest to it. Proceed to set the dial as before, but using pointer $H$ instead of the dial frame pointer $G$.

If it is desired to check up a pair of wheels, take a reading of each crank pin and add them together. If the two readings total 90 deg., the wheels are properly quartered and if the total does not equal 90 deg., either the wheels were not square originally, or the crank pins are worn. The gage will indicate the exact amount they are out.

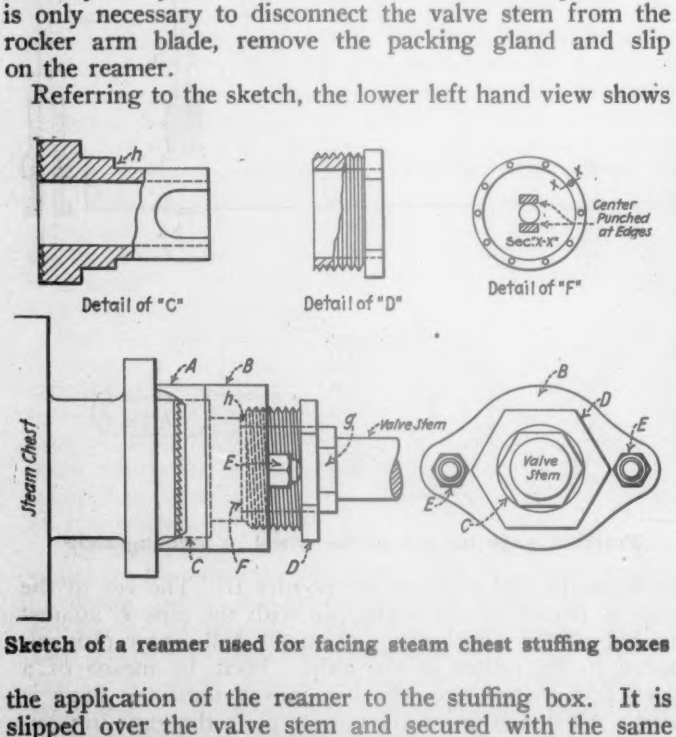
# Reamers for facing steam chest stuffing boxes

*By V. T. Kropid*

*Chief electrician, Winona Shops, Chicago & North Western, Winona, Minn.*

IT often happens that the joint between the steam chest stuffing box and the packing gland develops a leak. In order to save time, a reamer was devised in these shops whereby the joint could be faced off while in place. It is only necessary to disconnect the valve stem from the rocker arm blade, remove the packing gland and slip on the reamer.

Referring to the sketch, the lower left hand view shows




**Sketch of a reamer used for facing steam chest stuffing boxes**

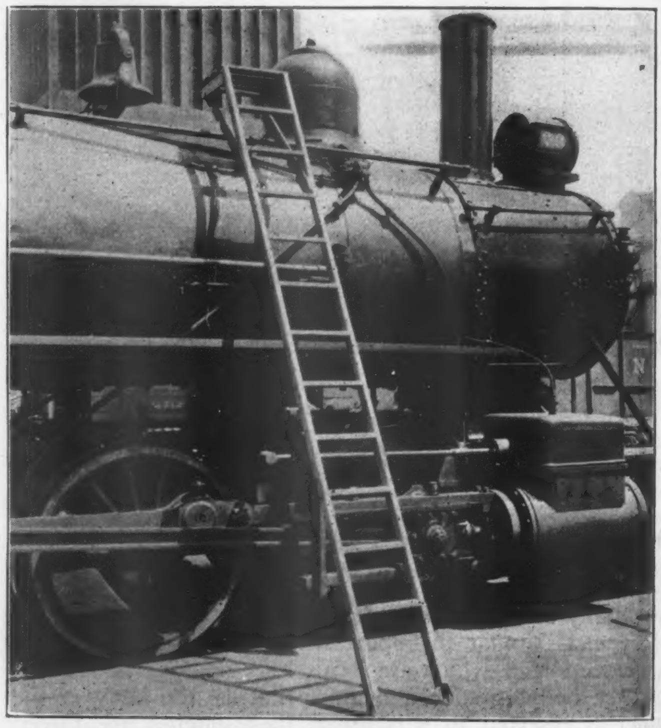
the application of the reamer to the stuffing box. It is slipped over the valve stem and secured with the same studs $E$ that hold the packing gland in place. The reamer $C$ has a hexagon shank $G$ to which the operator applies a wrench for turning the reamer. Referring to the end view, $A$ and $B$ are two old style packing glands machined to suit this purpose. The part $A$ is bored out large enough to go over the stuffing box, while $B$ is bored to suit the shape of the reamer and is threaded to take the feed screw $D$. The feed screw $D$ is provided with a hexagon projection for a wrench. There is a thrust bearing $F$ which bears against the shoulder $H$ of the reamer $C$, and against which the feed screw $D$ pushes.

Details of $C$, $D$ and $F$ are shown in the sketch. The homemade ball bearing has ten 1/8-in. balls. The ring of this bearing is 1/8-in. thick and 1/4-in. wide and has ten 9/64-in. drilled holes. The balls are placed in the holes which are made smaller at the edges by center punching around the holes to keep the balls from falling out of the retainer ring.

We found this reamer to be quite useful when we adopted a new type of packing. Of course, in applying the new packing glands the stuffing boxes all had to be faced square to the new glands. With this device we could change the packing in the enginehouse without having to wait to have the stuffiing box faced in the back shop.

# A safe enginehouse ladder

MANY types of ladders have been designed for use around locomotives in shops and enginehouses. The common type of straight ladder, even when equipped with non-slipping feet is not always the most safe and convenient. The accompanying illustration shows the



**A well-designed ladder for use in shops and enginehouses**

design of a ladder used on the Detroit, Toledo & Ironton which embodies both the elements of safety and convenience. As may be seen, it does not differ greatly from a ladder of the conventional type except that it is equipped with three-pronged feet and the platform at the top. The feet may be made of 3/8-in. steel plate fastened to the ladder side-rails either by bolts or lag-screws. The diagonal braces supporting the platform are notched in several places to fit over the hand-rails on the locomotive. The proportions of the ladder and location of the notches are such that a man may safely stand on the top platform without the danger of the ladder slipping to the floor.

# The Reader's Page

## Cleaning the interior of freight cars

BUFFALO, N. Y.

TO THE EDITOR:

I read with considerable interest the article on car department methods of cleaning the interior of freight cars, in your March issue. The method outlined is quite similar to that which we use in this territory. However, we have, a problem to solve which has given us more or less concern this winter. We clean and scrub the floors of freight cars in zero weather. The cars stand out in the open and considerable delay is experienced in getting them back into service because the floor does not dry. The first thing that we have encountered is ice forming over the wet part of the floor, which eventually melts and it is several days before the car is finally dried out. This, of course, depends entirely on the kind of weather we have while the car is in process of drying. During the drying period we are obliged to let the doors stand open to allow air to circulate through the car. But if it snows in the meantime, we get more moisture on the car floor.

Do you know of any good way of drying the cars that have been scrubbed, especially during the winter months when we have cold and wet weather to contend with?

A READER.

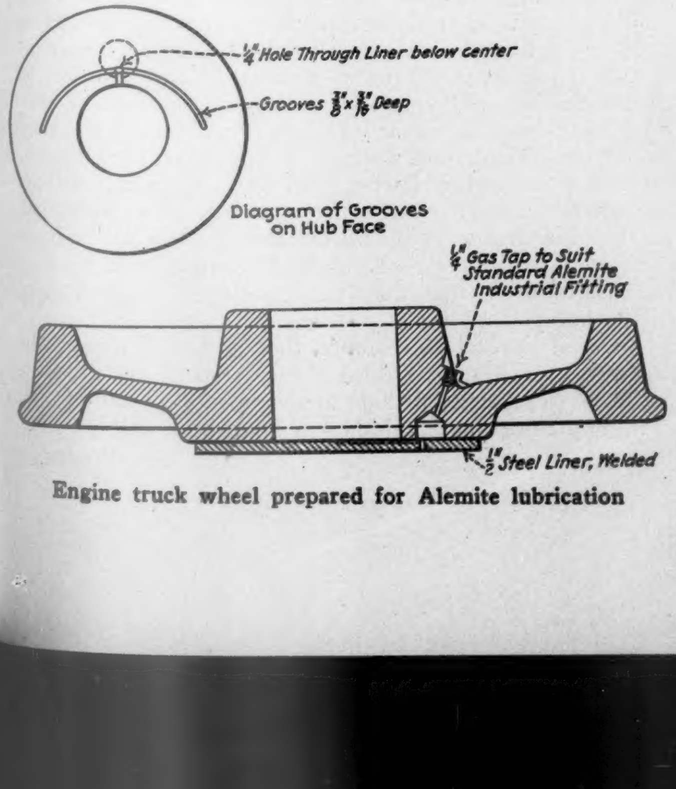
## One method of lubricating engine truck boxes

BATTLE CREEK, Mich.

TO THE EDITOR:

According to your editorial remarks in the February issue of the *Railway Mechanical Engineer*, considerable trouble is being experienced with hot engine truck bearings.

A year ago, the same trouble developed on a class of passenger power on the road by which I was employed. Care in the packing of cellars and the amount of lubricant used produces the same results—hot and scored journals. At the end of each trip, plenty of oil would be found around the outside of wheels and on the truck frames, but the bearings and cellar packing would be practically burned out.




Engine truck wheel prepared for Alemite lubrication

After a careful investigation, it was found invariably that friction commenced at the hub followed by excessive heat, which was transmitted over the length of the bearing. To overcome this condition, an Alemite connection was applied in an accessible position on the outside of each wheel and the wheel drilled as shown in the accompanying illustration. A shot of grease, with an Alemite gun at each terminal, resulted in the elimination of hot bearings on this class of power. The grease, in addition to keeping the hub cool, acted as a stop to the oil from being drawn out of the cellar by the centrifugal action set up by the revolving wheel.

The trailing truck hubs are taken care of in practically the same way, only that the Alemite connection is applied to the outside of the box. A pipe through the box conveys the grease to the hub face.

"PERKY."

## Gage for laying off driving box brasses

PORTSMOUTH, Ohio.

TO THE EDITOR:

The March issue of the *Railway Mechanical Engineer* contained a question from one of your readers, who signed

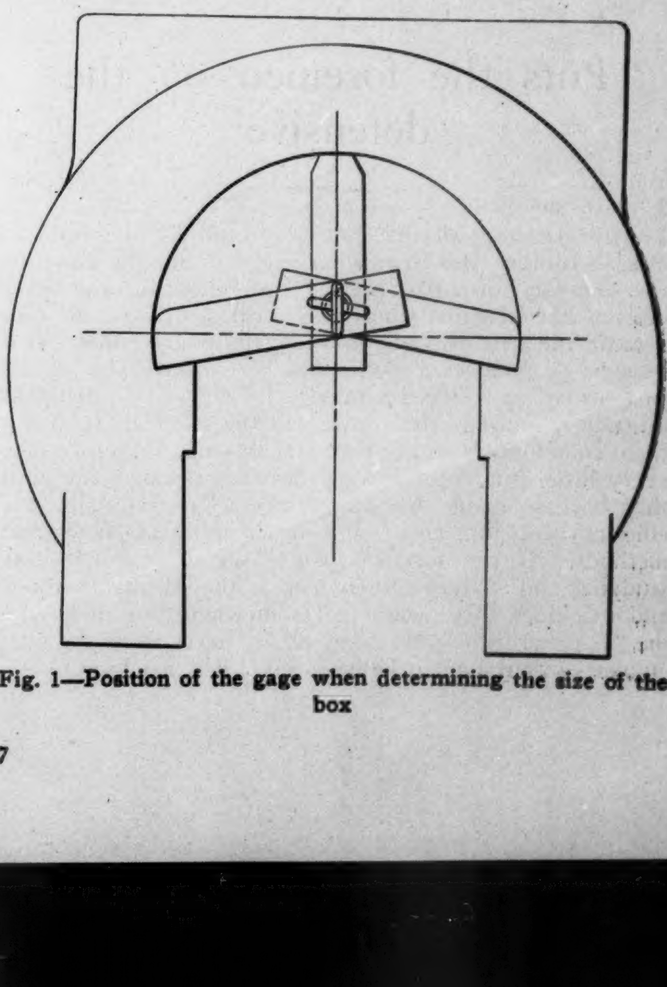


**Fig. 1—Position of the gage when determining the size of the box**

his name "A Constant Reader" wanting to know a good method of laying off a driving box crown brass for machining to fit in the box after it had been finished on the outside to the diameter of the box.

I have used several methods for doing this work and several different kinds of gages. The most simple gage I have ever used is the one shown in the accompanying illustrations. It is made of three pieces of 1/16-in. steel about 2 in. wide and 8 to 10 in. long, depending on the size of the driving box. A slot of suitable length is cut in each of the three pieces as shown. A screw, with a wing nut or a knurled headed bolt is provided for tightening the

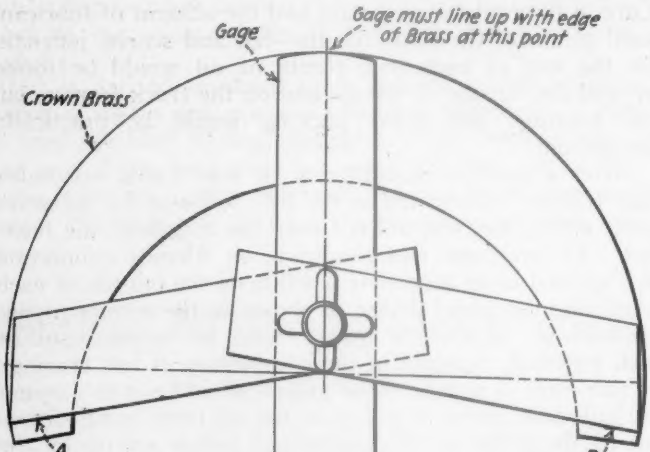



**Fig. 2—Position of the gage on the crown brass when scribing the lines at A and B**

gage after it is set to the size of the box as shown in Fig. 1. After the size of the box has been obtained by this method, the gage is removed and placed on the crown brass as shown in Fig. 2 and lines scribed at points *A* and *B* and the brass machined to these lines. With a little practice the machine operator can get the desired tonnage on the brasses by laying them off with a gage of this kind. This gage can be easily made in any shop or tool room.

J. H. Hahn,
Machine shop foreman, Norfolk & Western, Portsmouth, Ohio.

## Puts the foremen on the defensive

Railroad Shop, U. S. A.

To the editor:

After reading all that has been said by the railroad officials on the "Bill Brown" article, I decided it was time for some shopman to tell the "Top Sergeant" and other officials like him just where to get off at. From the way some of the articles read you would think a shopman—just because he punches a clock—is some animal who should just be fed and kicked around. I believe it is just that attitude of officials that causes all the trouble. It makes them contemptible to the man and the men therefore take every little thing up that they have a grievance for until they have so many that they strike. You can't get this efficiency you talk about just by changing machines and methods. If the foremen would spend as much time studying and analyzing their men as they do the methods and machines they would get somewhere, but men like the "Top Sergeant" and many others never think the man amounts to anything if he has a good new machine.

I am an average mechanic, work all the time and do good work, at least my work is never found fault with. I have many times suggested to the foreman what I thought was a better way to do certain things. Did I get any encouragement? I was told to never mind about those things. One time I made a jig to save myself a lot of labor and also time for doing the job. The foreman knew I was making it and when I got it on the machine I was enthused and got the foreman. He came around and when he saw it he said: "Take that thing off and if you spend any more time making stuff around here without first telling me I'll fire you." This was the same one who wouldn't listen to my other suggestions. I had worked out a model of this jig in wood at home and made the jig itself while my planer was working and kept my work up while doing it. I had to use surreptitious means to help myself and the company.

I often think foremen like to pick on men, for I know men who are good men and they don't dare look up from their jobs, while other fellows just do enough to get by with, which indicates that partiality and favoritism is shown by some foremen.

I tell you, you can't get anything out of a man by making him think you want to fire him every time you find him not hitting the ball. If the foreman is fair and square to a man he will do his best all the time, whereas if he is mean the man will only work when the foreman is watching him. This attitude is only true to human nature.

I have it figured out that many of the foremen think the men don't know anything but work and any suggestion that is made by a man is no good because the foreman didn't make it. A foreman shouldn't forget that he was once one of the "know-nothings" working at some job, and I'll bet he thought the same things then that we think of some of the foremen now, or in other words the foreman should not forget that he was once in the rank and file.

I don't want anyone to think I am dissatisfied with my job, but it could be made a whole lot more pleasant and I know the railroads would get lots more work out of the men. We have wives and children who like us to be pleasant and happy when home, but you can't have these things if every day at the shop you are getting bawled out for something or other. I would like more money, of course, but I realize that this isn't possible under present conditions and money isn't all. There are things a fellow can enjoy without money, if conditions where he works are pleasant. I belong to a labor union and always have, though I believe if the railroads would have a graduated scale of pay for mechanics—say from 50 cents per hour to 85 or 90 cents per hour, they would be doing a great thing. A man who was only getting 50 cents would always be studying, working and striving to be good enough and fast enough to pass the requirements for the higher rates. This would sure be an incentive and the railroads could help by holding classes for the men a couple of times a week. I'll bet every man in the shop would go. You could also grade them on the new ideas they have devised and when they were examined include the grade or merit on the rate. Would everybody then be thinking and working all the time? It is my opinion they would, for it is only natural for workmen to want to earn more so that they can give their families more of the luxuries of life.

I would like to have some other shopman answer the foremen's articles for I think these articles have given us a chance to present our side of the story, especially to the old "Top Sergeant" and those who believe in him.

Ed. Woods.

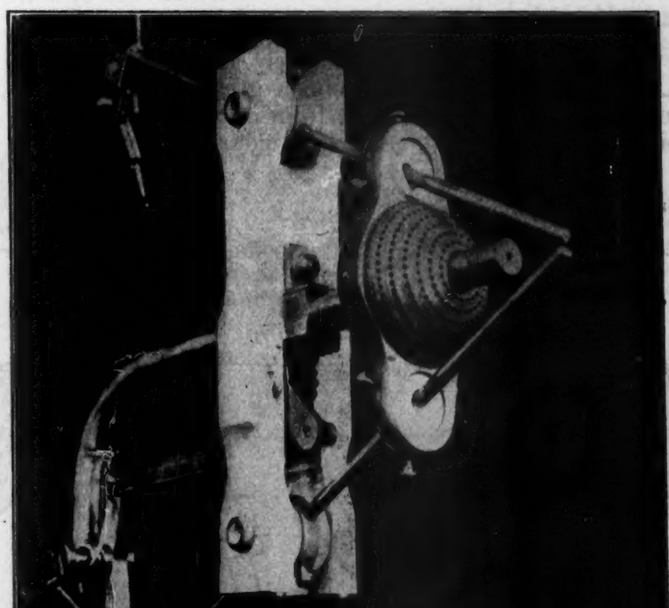

# Atomic hydrogen arc welding process

FIFTEEN years ago, while studying the loss of heat of the tungsten filaments of incandescent lamps in an atmosphere of hydrogen gas, Dr. Irving Langmuir of the General Electric Company research laboratory at Schenectady, N. Y., found that at a high temperature the hydrogen gas changed from the molecular to the atomic state. The molecular form is the more stable, and when the atoms recombine to form the molecules intense heat is liberated.

Welding with the atomic hydrogen arc

Continuing the theoretical investigation, Dr. Langmuir found that more atomic hydrogen was formed by passing powerful electric arcs between tungsten electrodes at atmospheric pressure. By directing a jet of hydrogen from a small tube into the arc, the atomic hydrogen could be blown out of the arc forming an intensely hot flame of atomic hydrogen which, in resuming the molecular form, liberates about half again as much heat as does the oxy-hydrogen flame. In this flame molybdenum, one of the most refractory of metals, melts with ease; quartz, however, melts less easily, in spite of its lower melting point. This indicates that the metal assists in the action as a catalyzer (a substance which accelerates a chemical change).

By this method iron can be welded or melted without contamination by carbon, oxygen or nitrogen. Because of the powerful reducing action of the atomic hydrogen, alloys containing chromium, aluminum, silicon or manganese can be welded without fluxes and without oxidation. The rapidity with which such metals as iron can be melted seems to exceed that in the oxy-acetylene flame,



Atomic hydrogen arc welding torch, Type I

so that the process promises to be particularly valuable for welding.

The two electrodes of the torch are tungsten rods, held at an acute angle with each other by lava insulators. When not in use, the electrodes are in contact with each other;

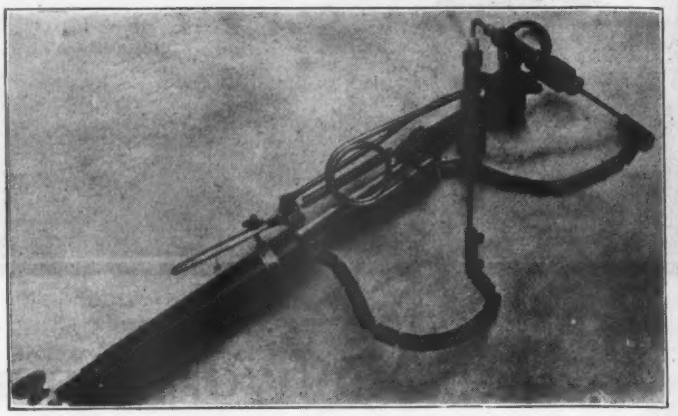
they can be separated by pressure on a lever mounted on the handle. A set screw is provided for making slow adjustments of the electrodes. The hydrogen is supplied by a tube through the handle. Sufficient gas is used so that not only are the electrode tips surrounded by enough gas to form the blast of atomic hydrogen but by an additional quantity to surround the work with hydrogen.

Either alternating or direct current can be used. The first mentioned has been found more convenient, and electrodes of smaller diameter can be used. The gas pressure required to operate the torch is very small; in the laboratory, with short lengths of tubing, a pressure of less than one pound per square inch was sufficient with metals up to one-half inch in thickness. For ordinary welding, the rate of gas consumption varies between 20 and 30 cu. ft. per hr.

Since the maximum rate of heating is desired in welding, the torch is held close to the metal. Best results have also been obtained when the torch is inclined so that the blast of hydrogen from the torch passes over the pool of molten metal in a direction opposite to that in which the torch is moved along the line of the weld. Experiments have been conducted with several gas mixtures and various electrode materials. The best results have usually been obtained with tungsten electrodes and hydrogen alone.

Materials of many kinds have been successfully welded by this method. Low carbon steels up to ½ in. in thickness have been welded without additional material after butting together tightly. Considerable work has also been done in connection with full automatic welding, using a butt joint and adding no metal to the seam. A number of welds have been made on seamless tubing having a wall thickness of ¼ in. and an outside diameter of 4 in., and with boiler plate one inch thick. Welds on deoxidized copper such as silicon-copper have been made on metal up to ⅜ in. thick, giving unusually good sections.

In testing welds made by this process, the welded portions have been twisted and bent double without cracking or otherwise being injured. Such a procedure has not been possible with the ordinary arc weld, since such welds are usually brittle because of the presence of nitrides or a thin film of oxide or scale, removed in the new process by the presence of hydrogen.

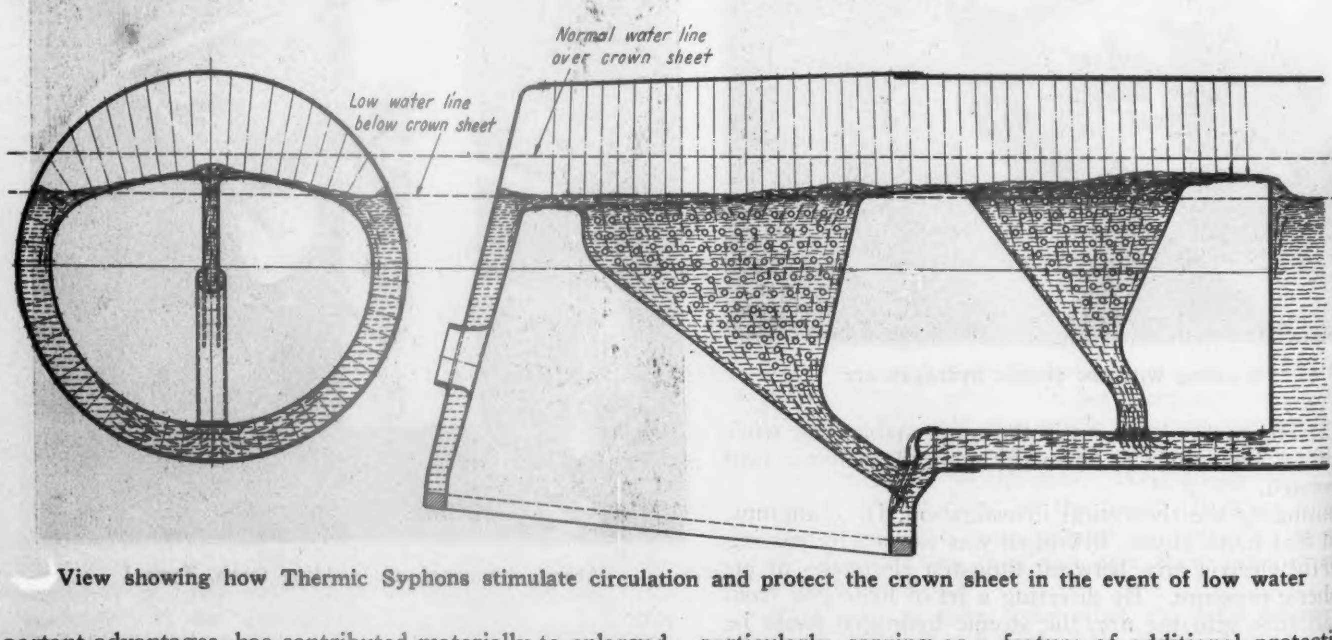


**Atomic hydrogen arc welding torch, Type II**

# Thermic syphons used in combustion chambers

The trend in locomotive boiler design has for years been towards proportionately larger grates and fireboxes in order to obtain greater capacity and more efficient transfer of heat from combustion gases to boiler water. One factor which, in addition to other important advantages, has contributed materially to enlarged firebox heating surfaces while taking but a small proportion of the total firebox volume above the arch, is the Nicholson Thermic Syphon and, to date, the Locomotive Firebox Company, Chicago, has placed in service Syphon equipment on 1906 locomotives for 78 railroads in this country and abroad.

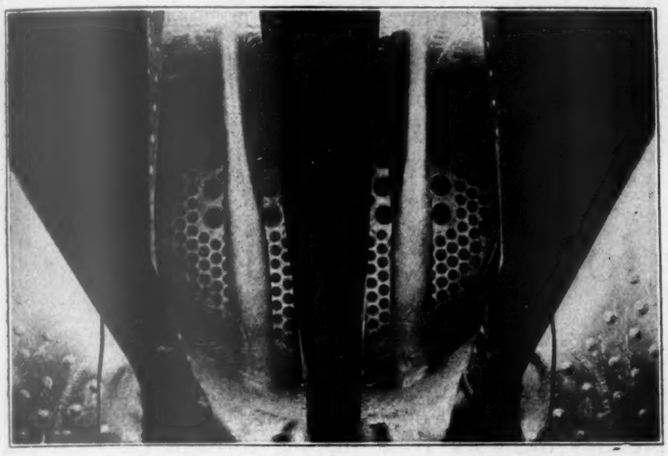
One or two units of Thermic Syphons are now being installed in the combustion chamber, thus adding to the heating surface in a location of great advantage but, more particularly, serving as a feature of additional protection in the event of low water.




**View showing how Thermic Syphons stimulate circulation and protect the crown sheet in the event of low water**

Thermic Syphons have prevented boiler explosions in several cases of low water, there being six definitely reported with water down from 3½ to 6

in. below the high point of the crown sheet. The pumping action of the Syphons in such cases causes the water to continue flowing from the Syphon opening over the crown sheet. This overflow serves to prevent general overheating of the sheet, which is further protected by the girder like support rendered by the Syphon. A small portion of the sheet ahead of the Syphon becomes heated, allowing one or more radials to pull through thus providing a gradual release of the pressure. Five of the above cases were on straight flue sheet boilers



**Syphon installation with two units in a combustion chamber**

with approximately 18 in. of space between the flue sheets and Syphons. A recent case of low water occurred on a combustion chamber boiler, Syphon-equipped, with a space of 43 in. between the flue sheets and the Syphons. Due to a larger exposed area of the crown sheet, 28 radials pulled through the sheet but no rupture occurred.

With the continued rise of the crown sheet, as in a combustion chamber design, it is a question of how long a chamber may be protected by a firebox Syphon. In the above case, the chamber was short, only about three feet, but many boilers have chamber lengths up to seven feet or more. By the addition of Syphons to the combustion chamber, an overflow effect, to protect the crown sheet in event of low water, is furnished in the same relation to location as on straight flue sheet boilers.

A combustion chamber application, in combination with the usual firebox Syphon, is shown in the drawing. Locomotives having this design modified to include two Syphons in the combustion chamber as shown in the photograph, are giving excellent performance.

It will be noted that the same design as the firebox Syphon is used in combustion chambers, being generally triangular in shape; made of firebox steel, with a 3-in. width of water space; staybolted in the usual manner. It is welded to the crown sheet in a similar fashion and the lower attachment employs a standard diaphragm welded to the bottom of the chamber. The structure, therefore, becomes a strut or column between the top and bottom sheets of the chamber with a very long top bearing and a comparatively short vertical dimension.

It is a known fact that some difficulty in the maintenance of combustion chambers has been experienced since their inception, which may be due to slow circulation of the boiler water. One purpose of locating Syphons in the combustion chamber is to draw water from around the chamber and discharge it above the crown sheet, facilitating the general circulation. That such a strong upward current through such Syphons exists has been proved by water marks on plates especially placed over them for record.

Another advantage lies in the addition of heating surface. In the installation shown, the heating surface of firebox and combustion chamber is 329 sq. ft. The firebox Syphon heating surface has 90 sq. ft., an addition of 27 per cent. The Syphon located in the combustion chamber has 20 sq. ft., or 6 per cent more, a total addition to the firebox and combustion chamber of 110 sq. ft., or 33 per cent of heating surface. When desirable, two Syphons can be applied to the combustion chamber, making a total of 39 per cent.

# Hoist for handling railway material

The hoisting unit shown in the illustrations is adapted to hoisting, loading and stacking stores material at store rooms, carrying materials from store rooms to locomotive shops and enginehouses, carrying the loads on the hoist boom or loading trailers and pulling the trailers to their destination and then unloading them. It is known as the Rix Fordson hoist and has been placed on the market by the Squier-Rix Company, 373 Broadway, Milwaukee, Wis. Simplicity of construction characterizes this hoist. It is designed to fit on the Fordson tractor without the necessity of drilling holes or in any way altering the construction of the tractor.

**Lifting and carrying a pair of car wheels**

The boom structure is of a rigid bridge construction

**The hoist, with loaded ballast box and wheels, has a capacity of 3,000 lb.**

designed to take care of swinging load streses which occur when the equipment is moving suspended loads. The boom elevating mechanism is of the regular double pulley and cable type. It is equipped with an 8-in. by 8-in. drum which will hold 100 ft. of 5/16-in. cable. The regular equipment includes 45 ft. of 5/16-in. flexible cable.

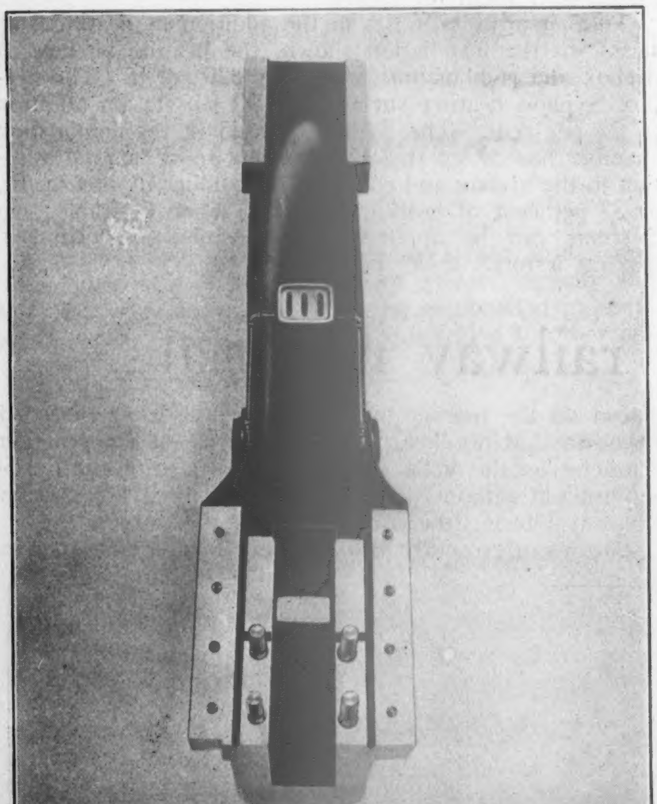
An automatic load brake which is standard on electric cranes is incorporated in the hoisting mechanism. This brake engages the load instantly when the power is released, preventing any possibility of the load dropping.

A limit switch is incorporated in the mechanism to prevent over-hoisting. The purpose of this device in a short lift portable hoisting unit is to insure the equipment and property against the forgetfulness of the operator in handling the control lever. This switch automatically throws out the control when the load is raised to the maximum height. An 18-in. by 18-in. by 2-ft. 9-in. ballast box is placed on the rear frame to add to the carrying capacity of the hoist. If not used for this purpose, it will serve as a tool box. The capacity of the unit is about 1,500 lb. when equipped with standard Fordson wheels and the loaded ballast box. The loaded ballast box, together with loaded and weighted wheels, will give the unit a carrying capacity of approximately 3,000 lb. The hoisting mechanism itself is designed and built for a maximum capacity of two tons.

This hoist is operated by means of one lever conveniently located near the operator's seat. It is built with lifts of 5 ft., 8 ft., 10 ft., and 14 ft., which gives a wide range of lifting heights for various services. The hook travel of the hoist is 23 ft. per minute. Ten horsepower of the capacity of the Fordson tractor is required to hoist and lower the maximum load.

# National high duty forging machines

THE features that have been added to the forging machines manufactured by the National Machinery Company, Tiffin, Ohio, has so increased their capacity, weight and speed of operation that they are now rated as high duty machines. The essential features of the National forging machine design have been retained,



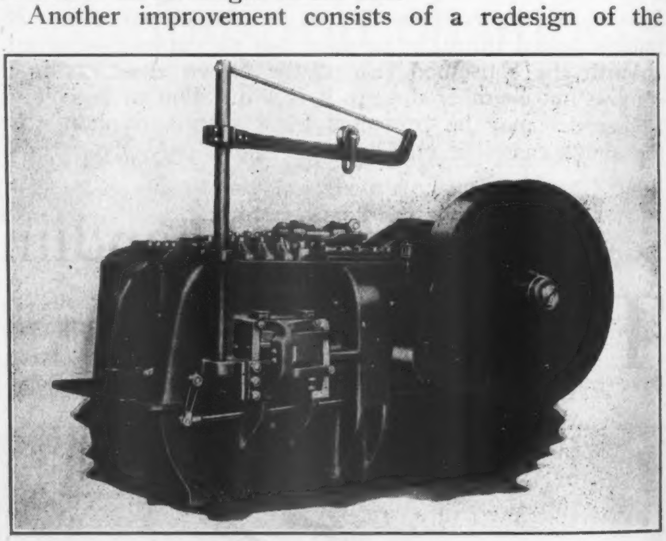
**The sliding head has been designed without shortening the tool holder slot, or without an increase in the length of the bed frame**

including the short and compact underslung bed frame; the suspended type heading and gripping slides; the patented automatic grip relief; the wedge type liner adjustments for the heading and gripping slides, and the friction-slip fly wheel.

The bed frames have been increased in depth and weight, thus giving a heavy type C clamp bed frame. This imparts a degree of rigidity which prevents the springing open of the bed frame, thereby eliminating swollen shanks, excessive fins, etc., on the forgings. This rigidity also prevents the work from slipping through the dies, and practically eliminates the necessity for back stops.

The compact bed frame design was made possible by the adoption of a new type over-arm heading slide which has only a part of its necessary length at the customary location ahead of the crankshaft, thus allowing a great reduction in the length of the bed.

Another improvement consists of a redesign of the

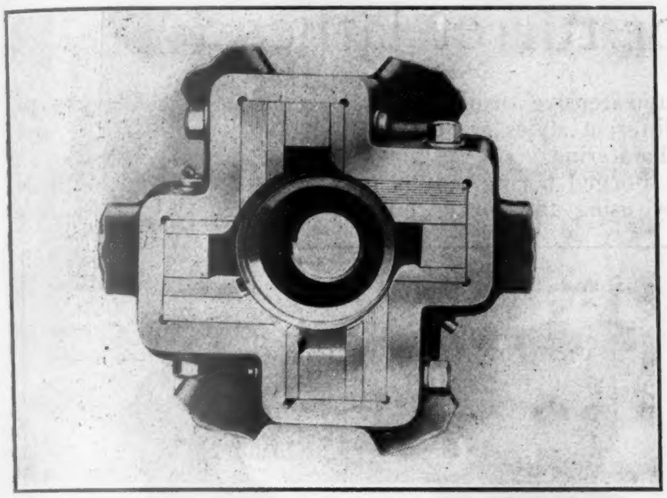


**A front view of the National high duty forging machine**

heading and gripping slides, providing them with over-arm or extended bearings, which serve to increase greatly the accuracy of the slide alinement. The heading slide, has been designed without shortening the tool holder slot, or without an increase in the length of the bed frame. This over-arm heading slide guides the heading tools with accuracy and freedom from side movement which allows more unsupported stock to be successfully gathered in one blow than on the older type of machines.

The grip slide has also been provided with an extended under-arm which prevents both sagging and rocking of the slide. By maintaining absolute uniformity of grip slide alinement, the grip dies can effectually grip the work through their entire length, thus preventing the work from slipping; and as the dies cannot rock or wobble,

there are no swollen shanks or excessive fins along the body or under the head of the forging. The customary knuckle block at the front end of the heading crank pitman has been replaced by two bronze bushed bearings in the cheeks of the heading slide, which operate in connection with a large round pin gripped in the front of the heading pitman. This has greatly increased the bearing area, and is claimed to have eliminated the trouble from



**Quadruple abutment starting clutch**

wear, caused by scale and dirt getting into the knuckle bearing.

Among other improvements is an increase in the depth of the die space, and as this increase has been made entirely below a center line passing through the crankshaft, it is now possible to use much higher dies than heretofore, without any tendency for the heading slide to raise out of its bearings. The dies can now extend considerably above the top of the grip slide and bed frame, without danger of the slide raising and breaking the slide caps, heading tools, etc., as in the other types of machines. This increase in the die capacity has greatly increased the range of work that can be handled upon these machines. Another point of considerable interest is that the length of the heading slide enables the downward pressure from the heading crank pitman to hold the front end of the slide in a down position, thereby resisting any tendency for the slide to raise when the work is above the center line. In the old style machines, with the slides entirely ahead of the crank connection, any pressure on the heading ram above the center line invariably raised the slide and accounted for the breakage of small diameter heading tools, punches, etc.

These machines are equipped with the customary National suspended type heading and grip slide bearings, which place the bearings above the path of scale and water; and all have the wedge adjustment at the side of the slides, so that merely by removing the top cap any side play can be removed without the necessity of removing the slides from the machine.

These machines are also equipped with the new quadruple abutment starting clutch, which causes the machine to start in one-quarter of a revolution. This gives practically instantaneous starting, resulting in a marked increase in output, and, in many cases, the elimination of a reheat on jobs requiring a number of blows.

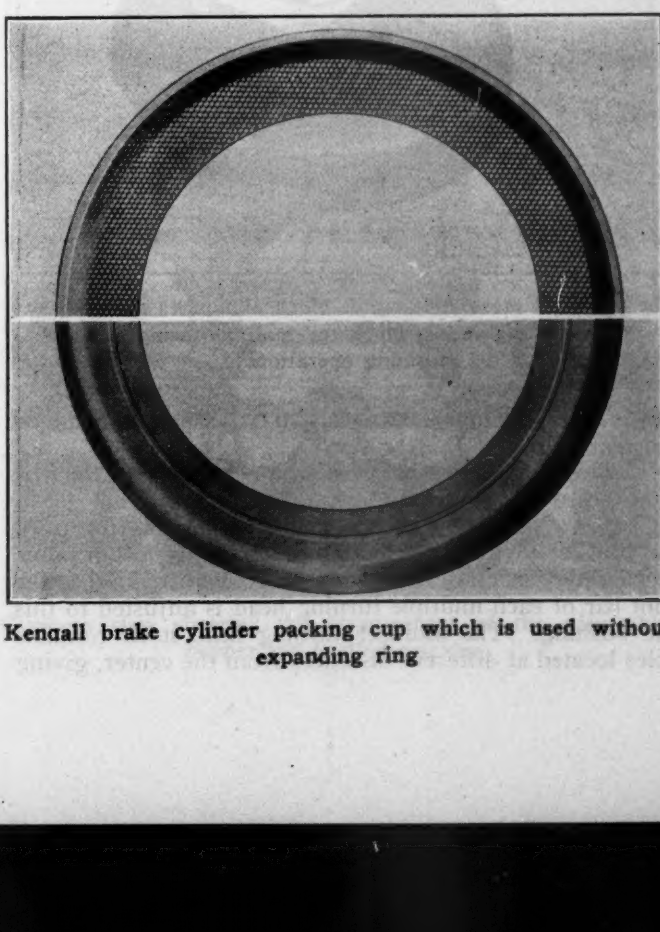
Another improvement has also been made in the design of the clutch mechanism. The clutch pin is now a large rectangular member having a large bearing area. It travels in a pocket in the hub of the crankshaft, and engages the hardened clutch abutment blocks in the main gear, which in turn are backed by laminations that cushion the starting movement and eliminate wear.

These machines are built in 2-in., 3-in., 4-in., 5-in., and 7½-in. sizes. They can be either belt or motor gear driven, using the friction-slip flywheel as the necessary safety for the motor.

# Packing cup meets tests

THE Committee on Brakes and Brake Equipment of the Mechanical Division, American Railway Association, has recently unanimously approved the report of a sub-committee recommending that the Kendall brake cylinder packing cup be recognized as standard A. R. A. brake cylinder packing and a price listed for it in the interchange rules. This decision was reached as a result of extensive tests on the Chicago & North Western, the Chicago, Rock Island & Pacific, and the Illinois Central. Following each leakage test, the air brake cylinder piston was removed and an examination made of the packing leather. It was noted that packing leathers in service for the longest periods of time had developed a more highly polished cylinder bearing than those of more recent application indicating that the life of Kendall cups will be of indefinite but long duration. Repair men in all cases were interviewed and the committee was informed that it has never been necessary to remove a Kendall pocking cup for any reason, nor has any difficulty been experienced in the initial application of these cups. Cars involved in the tests were selected at random, and no extra precautionary measures taken to improve conditions prior to the tests. There were instances when packing cups bore indentations, leaving but a narrow strip of bearing area, but even under these conditions the maximum leakage was but four pounds a minute.

The Kendall brake cylinder packing cups, some of which have been in service since 1921, consist of an outer cup member of krome leather with an inner cup member of

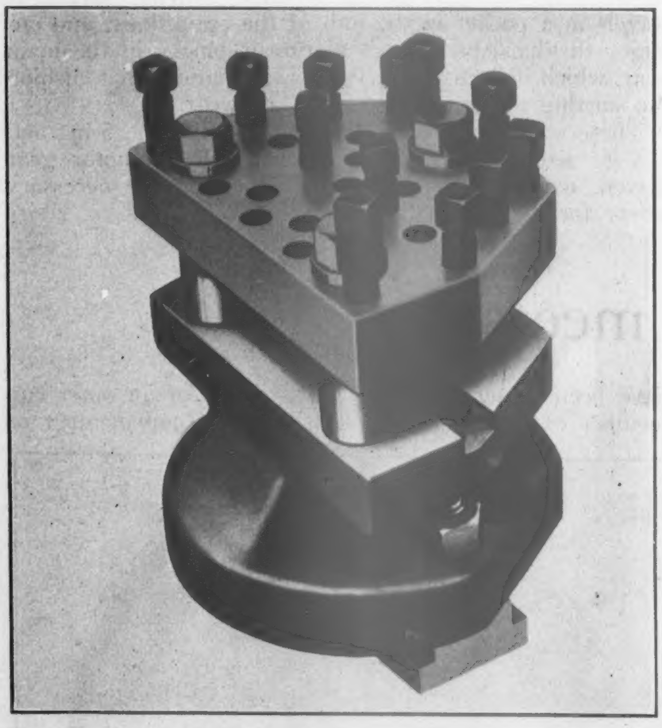


**Kenaall brake cylinder packing cup which is used without expanding ring**

canvas or other similar textile fabric firmly united by a cement which makes the cup impervious to air. With this method of manufacture, the cup is sufficiently rigid to retain its shape when attached to a piston head and to maintain close contact with the inner face of the cylinder without the use of an expander ring. Easy application, durability, reduction of air leakage, and freedom from cracks and breakdowns due to temperature changes, moisture, or the use of any standard brake cylinder lubricant, are features claimed for this new cup, which is made by the Air Brake Cup Packing Company, Chicago, and sold by the Gustin-Bacon Mfg. Co., Kansas City, Mo.

# Universal tools for turret lathes

THE Warner & Swasey Company, 5701 Carnegie Avenue, Cleveland, Ohio, has developed a new series of tools designed for making multiple and combined cuts for use in connection with its Nos. 1, 2, 4 and 6 turret lathes. The following is a description of the multiple turning head with overhead pilot attachment; multiple cutter holders; off-set cutter holders and the cross slide cutter blocks. The multiple turning head with an overhead pilot adjustment is a tool particularly adapted for small and average lot work of medium or heavy type. Since with this tool heavy feeds may be taken without using special pilot bars, the overhead pilot bar, which has a radial adjustment to compensate for wear without sacrificing rigidity, is supported in the multiple turning head by four screws giving a four-point bearing for alinement with a bushing on the head of the machine. This is a patented feature. After proper alinement is secured, the

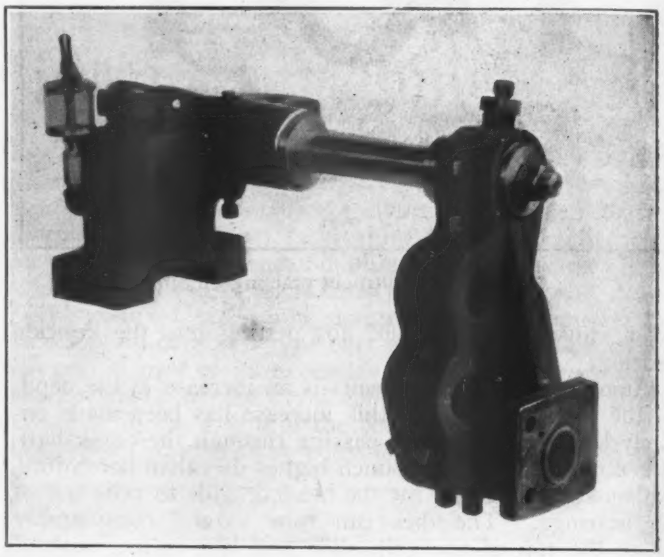


The universal cross slide cutter block eliminates the necessity of making special blocks on multiple facing and forming operations

bar is firmly clamped by means of a washer and nut on the rear end.

The overhead pilot bar passes into a bracket which is attached to the front of the head. The adjustable bushing, also a patented feature, makes it possible to attach the bracket to the machine when not in use. Only one bracket and bushing are required for each machine as the pilot bar of each multiple turning head is adjusted to this one bushing. The multiple turning head itself contains holes located at different distances from the center, giving an extensive turning range. Various cutter holders of different styles are used for turning, boring, facing and chamfering.

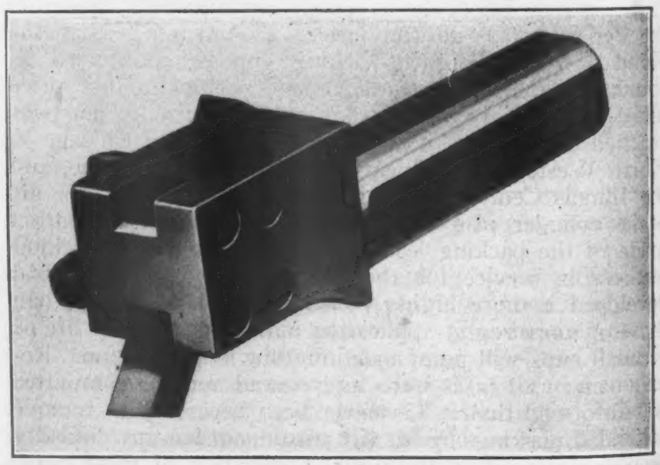
Forged boring cutters may be held in the center hole by using the rocker bushing shown. The center hole



Warner & Swasey universal multiple turning head with overhead pilot attachment

may also be fitted with stub boring bars, drills, reamers, pilot bars and similar tools. The head itself is heavy and rigid and is designed to afford suitable tool clearances.

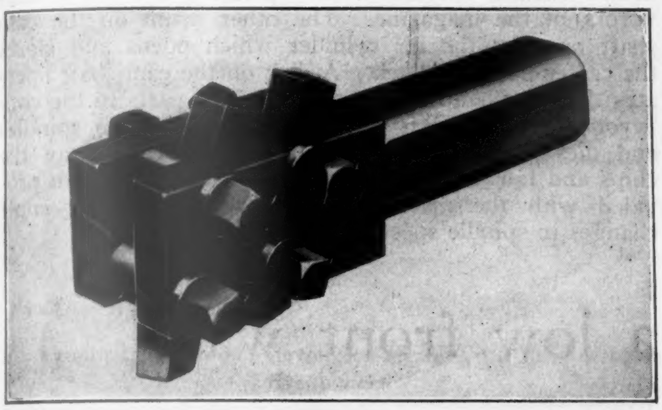
The multiple cutter holder is for use in the multiple



The off-set cutter holder is designed to provide maximum support for the cutters

turning head just described. The holder carries two cutters which are adjustable to different positions for turning two diameters at the same time, or for turning and facing. Tie screws and bushings are furnished to prevent the

slides from springing apart when clamping the cutters. A variety of holes makes it possible to shift these to different positions for a wide number of combinations of tools. The holders may be moved in and out of the heads



**The multiple cutter holder may be used for turning two diameters at the same time or for turning and facing**

for the length of the cut. The entire holder is hardened and the shank is ground and flatted.

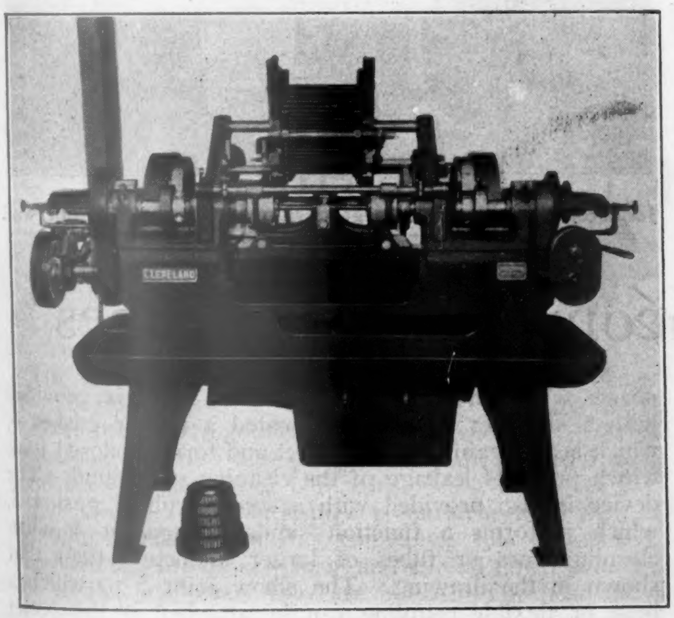
The off-set cutter holder is also used in the multiple turning head when the cutter would project too far if used in the straight or angle cutter holders. Better support is given to the cutters, particularly when using stellite. Slots for the cutters are grooved from the solid, leaving tie pieces between the sides of the holder to prevent them from springing.

The holder is moved in and out of the heads for the length of the cuts. The cutter is held by two screws. The entire holder is hardened and the shank is ground and flatted. Often when two diameters of different sizes must be turned and bored, this tool is desirable to reduce the overhang of the cutters by stepping down and stepping up with these holders.

The cross slide cutter block is a tool designed to eliminate the necessity of making special cutter blocks and cutters for each individual job when performing multiple facing and forming operations on the cross slide. These cutter blocks are available either for the front or rear, the rear block being higher than the front one. It is possible to set each block in four different positions on the cross slide and by different arrangements of cutters in each of these positions, a great variety of combinations can be obtained. Inexpensive forged cutters may be used so that when it is desired to change from one job to another it is necessary only to regrind and set the cutters. This cutter block is of heavy rigid construction and made entirely of steel.

# Double end stud and pipe nipple threader

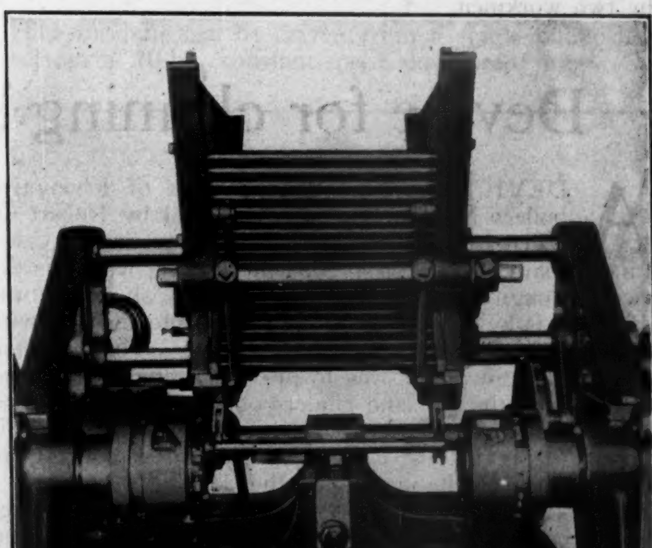
A NEW machine, designed for the production of work requiring double end operations such as the threading of pipe nipples and studs, has recently been placed on the market by the Cleveland Automatic



**Front view of Cleveland double-end stud and pipe threading machine**

Machine Company, 2269 East 65th street, Cleveland, Ohio. In the design of this machine, which is known as the Model "J" the manufacturers have departed from the usual custom of revolving the work while the tools remain stationary, and have arranged the machine to rotate the tools and carry them on to the work which is held in a stationary center chuck. This model is manufactured in two sizes, one for threading pipe nipples up to 2 in. pipe size and for studs up to 1½ in. diameter, the magazine handling lengths from 1½ in. to 14 in. The smaller size will thread pipe nipples up to ¾ in. pipe size and studs up to ¾ in. diam.—the capacity in length being from 1½ in. to 12 in. In addition to pipe work, steel, brass and cast bars as well as steel and brass tubing within the capacity range can also be handled.

The machine is equipped with a Cleveland hopper magazine located in the center, which is arranged with oscillating levers, timed from the cam shaft to control the dropping of the parts to sliding conveyor fingers which



**Close-up view showing the arrangement of the adjustable hopper and feeding machine**

carry each piece to an air-operated floating center chuck. Power is supplied by either a single pulley belt or motor drive and is controlled by a hand lever operating a clutch in the driving pulley. The tool feed is engaged or disengaged by a hand lever. The machine may be turned over by hand by means of a crank on the shaft to the left of the tool feed hand control lever, thus providing complete control of the machine.

The machine is equipped with a special safety device which is regular equipment on machines manufactured by this company. This functions by shearing off a pin in the worm-gear drive, causing the feed to stop, thereby preventing damage to any part of the machine or tools in the case of the accidental jamming of tools. This safety pin is easily replaced and the machine is ready to operate. The tool feed to the two tool spindles is furnished through cams mounted on the circumferences of two drums on a cam shaft. Cams on the side of one of the tool feed drums furnish the action for operating the finger conveyors in the magazine. The other drum on the cam shaft operates the air cylinder which opens and closes the center floating chuck. A disk on the cam shaft operates the lever controlling the feeding of parts to the conveyor fingers. Oil is carried through the two spindles and dies in a constant stream which clears away the chips and lubricates the chasers. Change gears are provided with the machine which will permit of ample changes in spindle speeds.

# Rivet forge with a low front wall

THROUGH experience, the engineers of the Johnston Manufacturing Company, Minneapolis, Minn., found that the high front walls of portable rivet forges are unsatisfactory as the rivets which dropped behind this wall were nearly inaccessible because of the gases blown out through the charging opening. This undesirable feature is overcome by making the front wall only 2 in. high in the new No. 15 portable rivet forge recently placed on the market by this company.

In this forge a large proportion of the gases is discharged through a vent at the left rear corner of the chamber and only a small part passes through the charging opening. The gases coming out through the charging opening are, moreover, held back by an air curtain. This curtain is of a new type which contains large holes but is so arranged that it is said to use only a small amount of compressed air. The forge is equipped with the Johnston non-clogging vacuum burner, which has been described on page 501, in the August, 1924, issue of the *Railway Mechanical Engineer*. The lining of the forge is of a good grade of firebrick, set in high temperature cement. Owing to the quality of the material and the uniform heat produced by the burner, it is claimed that the lining will last until the floor of the forge is worn out by the handling of rivets. The machine can be easily carried by two workmen.

**Johnston portable rivet forge designed with a low front wall**

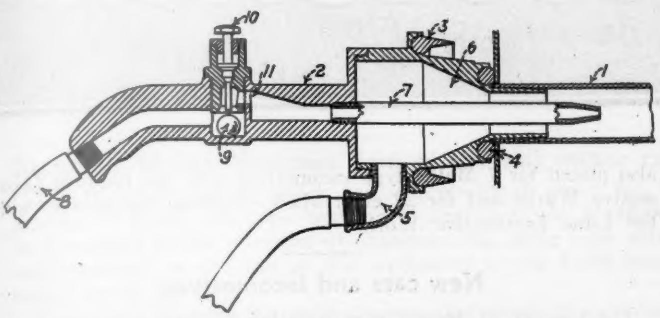
# Device for cleaning locomotive boiler tubes

A DEVICE for cleaning the flues of locomotive boilers has recently been patented by Robert D. Kilcrease, enginehouse foreman, Atlantic Coast Line, Albany, Ga. The method of cleaning with this device, a longitudinal section of which is shown in the drawing, is by forcing a cleaning fluid into the flue with compressed air from the shop air line. The principal object of the inventor was to provide a flue cleaner that would force the dirt and cinders out of the opposite end of the flues in case it was not entirely closed, and if closed, to prevent the cleaning compound and dirt from flowing back on the man doing the cleaning.

Referring to the reference numbers on the drawing, 1 is a portion of the boiler flue next to the flue sheet. The flue cleaner comprises a tubular body 2, one end of which is turned down for a hose or flexible coupling 8, to be coupled to the body. The body is expanded as shown in the drawing and the head of the cleaner is screwed into it. The forward part of the head forms a nozzle which fits into the flue. The head is provided with a shoulder in which is seated a rubber gasket 4, which bears against the flue sheet and forms a closed joint which prevents leakage of the cleaning compound. The device is also provided with a second rubber gasket 3, which performs a function similar to gasket 4 when cleaning flues or tubes of larger diameters than that shown in the drawing. The elbow joint 5 to which a hose or flexible coupling can be attached is the outlet through which the cleaning compound, scale and dirt can escape from the enlarged chamber in the head when backed up on account of the flue being choked.

The flow of cleaning compound which is forced through the hose 8 is controlled by the valve 10. It will be noted that the inlet and outlet parts of this valve are not in alinement. The inlet part leads into a chamber in which is a ball 9. The stem of the valve 10 rests on a plunger which seats by its own weight. The ball 9, of course, can also drop to the floor of its chamber by its own

weight. When the cleaning compound under pressure is admitted to the ball chamber, it lifts the ball against its seat and at the same time raises the plunger. The ball is thus held by the pressure of the fluid until the device




**Longitudinal section of a device for cleaning the flues of locomotive boilers**

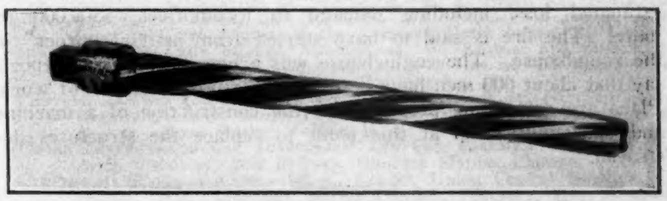
is ready for operation. When ready, the operator presses down on the handle of the valve 10 which depresses the plunger and forces the ball 9 from its seat, allowing the cleaning compound to flow through the port 11 and escaping with considerable velocity through the nozzle 7. If the flue is not completely closed by the accumulation of cinders and other particles, the force of the cleaning compound will carry the accumulations out through the opposite end of the flue. If the flue should be completely choked or nearly closed, the pressure of the fluid should be sufficient to dislodge the particles. Any back pressure created carries the loose particles through the outlet 5. This arrangement prevents the dirt and fluid from flowing back on to the operator which relieves him of considerable annoyance.

The body of the flue cleaner is shaped so that it forms a convenient handle which may be comfortably gripped by the operator. The design of the valve 10 is such that it is easy to operate, only a slight pressure on the handle being required to permit the cleaning compound to enter the flue with considerable force. The operator may also stop the flow of the cleaning compound by removing the pressure on the valve handle in case he desires to observe the progress of the work or to move to the next flue. This flue cleaner is designed to operate most effectively with from 70 lb. to 130 lb. pressure.

# Celfor high speed locomotive frame reamer

CELFOR high speed locomotive frame reamers are now manufactured by the Clark Equipment Company, Buchanan, Mich., to the specifications adopted by the American Railway Tool Foremen's Association at its meeting in Chicago in September, 1925. The four flute reamers are made by the hot twisted process; the six flute reamers are milled. The standard practice calls for 1/16 in. taper to the foot, but any taper desired can be furnished. The reamers have a left hand spiral of 12 to 22 deg. depending on the size; square shanks or tapered shanks are also furnished.

The flutes are machine ground on the cutting edge which can be relieved with either a double or eccentric relief. The reamers are recessed under the head to pro- or from a 10-hp. constant-speed dust proof motor.



**Reamer designed according to the specifications adopted by the American Railway Tool Foremen's Association**

# Motor driven 36-in. by 36-in. crank planer

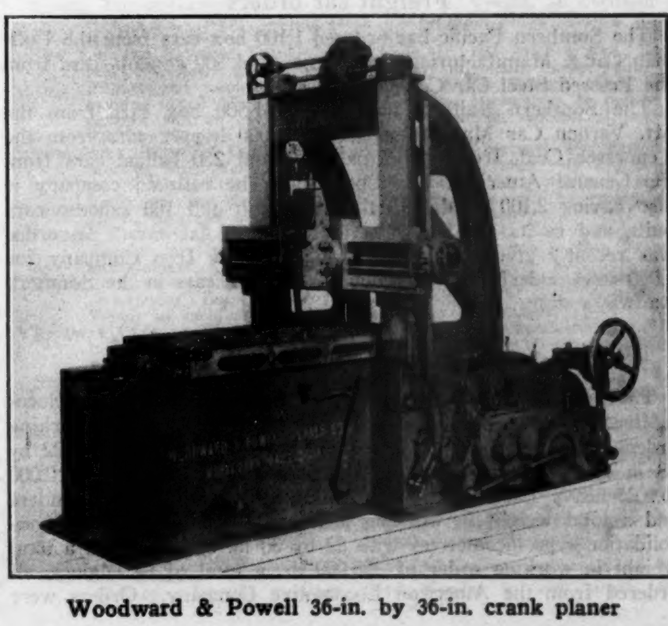
THE 36-in. by 36-in. crank planer, illustrated, has been added to the line manufactured by the Woodward & Powell Planer Company, 97 Webster Street, Worcester, Mass. The maximum stroke of the machine is 42 in.

The table is of box form and the work can be placed anywhere on it to come under the tool. The table drive is through a herringbone pinion and gear and a slotted rocker mechanism. The pin on which the slotted rocker oscillates is supported at both ends.

The design of the housings is uniform with that of the other machines in this company's line of planers. The housings are of box form and extend down over the side of the bed where they are bolted. The head is of the same size and design as that used on the company's standard, rack-driven, 36-in. planer. It has the usual horizontal, vertical and angular feeds either by power or by hand. The cross-rail has power elevation. A side head can be furnished if desired.

Six changes of speed are furnished on this model. They are 6, 8, 12, 17, 24 and 34 strokes per min. The changes are made through sliding gears mounted in a gear box at the front of the machine. The length of stroke is changed by means of a handwheel located on the operating side of the machine. A dial adjacent to the handwheel indicates in inches the stroke.

The machine can be driven from a single pulley belt or from a 10-hp. constant-speed dust proof motor.



**Woodward & Powell 36-in. by 36-in. crank planer**

# News of the Month

The Austrian Federal railways have invited tenders from domestic locomotive builders for 30 express, 100 passenger and freight, and 50 switching locomotives, valued at $3,500,000. These are to replace 555 old engines, whose cost of upkeep is estimated at $800,000 annually.

Safety Committees of the Southern Pacific received from employees during 1925 a total of 4,469 suggestions designed to correct unsafe practices and conditions. Of these suggestions 3,248 were adopted. A total of 1,184 foremen in charge of work crews established records of complete freedom from reportable accidents throughout the year.

The combined forces of the purchasing and stores departments of the Bangor & Aroostook gathered at Derby, Me., on February 16 for an inspection of the principal shops and general storehouses of the company, after which they were entertained at a banquet in the company hotel where several of those present, including C. D. Baldwin, purchasing agent, spoke on various phases of the purchasing and stores work. The event is the first of its kind in the history of the road and is expected to become an annual affair.

The locomotive shops of the New York, Chicago & St. Louis at Frankfort, Ind., were mostly destroyed by fire on March 9; estimated loss, including damage to locomotives, $500,000 or more. The fire is said to have started from an "oil burner" in the roundhouse. The enginehouse was a new one. Press reports say that about 600 men have been temporarily thrown out of work. Plans are now being prepared for the construction of a machine and blacksmith shop at this point to replace the structures destroyed.

## Colonie car shops break safety record

The car shops of the Delaware & Hudson at Colonie, N. Y., employing approximately 475 men, on March 7 completed two years without having a reportable injury among its employees. This means that the men worked almost 2,000,000 man-hours without any individual losing more than three days, due to injury suffered while in the performance of his duties. This is believed to be a world record in this respect and is to be commemorated in a suitable celebration on Monday evening, April 12.

## Freight car orders

The Southern Pacific has ordered 1,100 box cars from the Pullman Car & Manufacturing Corporation and 500 gondola cars from the Pressed Steel Car Company.

The Southern Railway has ordered 1,500 box cars from the Mt. Vernon Car Manufacturing Co., 1,000 hopper cars from the Tennessee Coal, Iron & Railroad Co., and 250 ballast cars from the General American Car Company. The railroad company is also having 2,100 gondola coal cars rebuilt and 100 caboose cars built, and in its own shops is building 500 flat cars. An order was recently given to the Virginia Bridge & Iron Company for 1,000 steel underframes to be applied to box cars in the Southern Railway's shops.

## Southern Railway orders 113 locomotives

The Southern Railway has ordered 46 heavy Mikado type locomotives with 27 by 32 in. cylinders and a total weight in working order of 325,000 lb., 5 light Mikado type locomotives with 22 by 28 in. cylinders and a total weight in working order of 210,000 lb., 23 heavy Pacific type locomotives with 27 by 28 in. cylinders and a total weight in working order of 304,000 lb., and 10 consolidation type locomotives with 22 by 30 in. cylinders and a total weight in working order of 250,000 lb., a total of 84 engines, all ordered from the American Locomotive Company. Orders were also placed for 7 Mallet type locomotives with the Baldwin Locomotive Works and for 22 eight-wheel switching locomotives with the Lima Locomotive Works.

## New cars and locomotives

The number of freight cars installed in service in the month of January was 4,907, as shown by reports of the Class I railroads filed with the car service division of the American Railway Association. The total in January, 1925, was 12,735 and in January, 1924, it was 16,192. The present total of 4,907 includes 1,345 box cars, 2,747 coal cars and 325 refrigerators. Freight cars on order on February 1 totaled 50,636, including 24,858 box, 21,298 coal and 1,808 refrigerator cars. On February 1 last year freight cars on order totaled 59,295 and the year before that 25,390.

Locomotives placed in service during the month of January this year totaled 191 compared with 167 in January, 1925, and 271 in January, 1924. Locomotives on order this year, 493, compared with 280 last year and 439 on the same date two years ago.

These figures include new, rebuilt and leased equipment.

## B. & M. to reclaim coke from locomotive ashes

A plant for reclaiming coke from locomotive ashes is to be constructed by the Boston & Maine at East Somerville, Mass., adjacent to its enginehouse and shops. It is expected that the railroad will be able to obtain in this manner practically all the fuel required for station heating. Present station requirements aggregate approximately 30,000 tons a year.

This project, so far as known the first of its kind by any railroad in this country, will recover from the locomotive waste now dumped into ash heaps unburned coke which tests have shown to average from 33 to 40 per cent of the ash. The Boston & Maine expects to recover approximately 30 per cent by the new process.

This process is an adaptation of one used in the hard coal fields for separating impurities. It is based on the comparative specific gravity, and by means of water flotation the coke is segregated and the cinder residue precipitated.

The new plant will cover an area approximately 30 ft. by 100 ft. It will cost about $50,000, and will handle 2,000 tons of ashes weekly, from which approximately 600 tons of coke is expected to be reclaimed. The cinders to be handled by the new plant will be largely those dumped from locomotives in Greater Boston enginehouses and shops, but if the results warrant, the reclamation process may be extended to apply to the ashes from locomotives elsewhere on the system.

## Northern Pacific locomotive makes 1800 mile run

The Northern Pacific has just completed a record-breaking continuous freight run, handled by a single locomotive, from its Seattle freight terminal to its Twin Cities freight terminals. The distance of 1,897.6 miles, over three mountain ranges with a maximum grade of 2.2 per cent, was covered in 109 hr. 30 min. total time, with a coal-burning locomotive which was not detached from the train nor given any mechanical attention whatever at terminals during the entire trip. An average speed of 17.4 miles an hour was made, including stops which aggregated 4 hr. 43 min. at terminals for tonnage changes.

The locomotive is of the Mikado type, having a tractive force of 57,100 lb., and is equipped with a stoker, trailer booster, superheater, feedwater heater and round hole type of grates with a restricted air space opening of 12½ per cent. The grates are designed for burning the semi-lignite and screenings coal ordinarily burned over a portion of the line and which permitted on this particular trip the burning of four different kinds of coal, including the semi-lignite, without the necessity for cleaning fires at

terminals. It was estimated that a total of 353 tons of coal and 442,000 gal. of water were consumed on the trip.

A full-tonnage train was handled over all divisions, the train load varying from 1,600 to 5,000 tons according to the grade, and consisted of 84 cars over the eastern end of the line.

The locomotive was taken from regular pooled freight service and started on the run with only the customary inspection and needed running repairs. Sixteen engine crews were taken in their turn from chain-gang freight service to handle the locomotive over the territory which, in ordinary operation, requires 12 locomotives.

### Boston & Maine discusses field of the rail motor car

The Boston & Maine, which has just placed an order for 10 gas-electric motor rail cars, bringing to approximately $1,000,000 its investment in this character of equipment, has made some pertinent comment on the use of this equipment in the forthcoming annual report for 1925.

The report contains the announcement that three of these new cars, seating 90 persons each and equipped with double-end control, will be used in suburban service at other than rush hours. The report continues:

"While there is a field for the self-propelled passenger car on steam railroads, the scope is by no means universal. The power and capacity of such cars are inadequate to meet the peak requirements of commutation traffic, and in the case of short branch lines with very light traffic, the investment and operating cost are out of all proportion to the revenue. In the former class of traffic, motor rail cars cannot satisfactorily replace steam with the greater capacity of the latter for handling peak loads; in the latter class, the highway bus appears to furnish the economical solution.

"There is an intermediate field, however, where the passenger traffic does not warrant steam service, and in some instances the introduction of a less expensive substitute may permit of greater frequency of service and result in the retention of traffic which otherwise would be diverted to public or private transportation on the highway."

Most of the new cars, like most of the 13 which are now in operation, are intended to supply such an improved and economical service for branch lines. Discussing further the use of this equipment, the Boston & Maine's report says:

"While the development of gasoline motor cars for passenger transportation on the rails cannot be said to have passed beyond the experimental stage, the economies as compared with steam service have appeared to be sufficient to justify a substantial investment in this type of equipment.

"The Boston & Maine now has in service 13 gasoline rail passenger cars of which eight are mechanically driven and five are of the gas-electric type. Eleven additional cars are now under order —all of the gas-electric type.

"These cars are being operated on both main lines and branches, the following runs being indicative of the service to which they are believed to be adapted: Boston-Northampton, North Adams-Troy, Nashua-Worcester, Portland-Rochester, Salem-Lowell, Springfield-Greenfield.

"Practically all of these cars are intended to haul an additional car of light construction. Among the cars under order, however, are three with double-end control having a seating capacity of over 90 passengers. These are intended for interurban service at other than rush hours."

## Meetings and Conventions

### National Committee on Wood Utilization to meet April 28

Herbert Hoover, Secretary of Commerce and chairman of the National Committee on Wood Utilization, has called a meeting of the National Committee members for April 28, 1926, at its headquarters in the Department of Commerce, Washington, D. C. This committee, established by direction of President Coolidge, is composed of important consumers, distributors and manufacturers of wood and wood products who aim to promote a more efficient utilization of wood that more and better lumber and wood products may be produced from each tree, thereby effecting a saving in the number of trees necessary to be cut to supply the nation's timber needs. Heretofore, but from 25 to 35 per cent of the standing tree has been marketed, and, in order to increase this percentage, the committee will consider at its meeting on April 28 a wide range of suggestions for undertakings to eliminate wood waste. Its work, through sub-committees composed of leading technical and practical men in each special field, will extend into the manufacture of lumber, pulp, paper, wood chemicals, naval stores, charcoal, composition board and other by-product possibilities. Means and methods whereby the transportation and distribution of lumber and wood products will be effected in a more efficient and economical way, and efficient logging, saw milling and wood working practices also will receive careful study.

*The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.*

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Next convention May 4 to 7 inclusive, Hotel Roosevelt, New Orleans, La.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 9-16, inclusive, Young's Million Dollar Pier, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Next meeting September 21-23.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York. Next meeting, June 9, 10 and 11, in the Vernon Room of the Haddon Hall Hotel in Atlantic City.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago. Annual convention September 1-3, Hotel Sherman, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Annual meeting June 21-25, Atlantic City.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charron St., Montreal, Que. Regular meetings second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting April 13. Paper on freight claims will be presented by C. F. Macdonald, freight claims agent, Boston & Maine, Boston, Mass.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, Great Northern Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—R. E. Giger, 721 North 23rd St., E. St. Louis, Ill. Meetings, first Tuesday in month, except June, July and August, at the American Hotel Annex, St. Louis.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York, N. Y. Regular meetings, second Thursday each month, except June, July and August. Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—A. S. Sternberg, Belt Railway, Clearing Station, Chicago.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Meetings, second Tuesday, February, May, September and November.

CLEVELAND STEAM RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month except July, August and September, at Hotel Hollenden, East Sixth and Superior Ave., Cleveland, Ohio. Next meeting April 5. A paper on the preparation of freight car brakes for the descent of mountain grades will be presented by W. F. Peck, supervisor of air brakes, B. & O., Baltimore, Md.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich. Next convention August 17-19, Hotel Winton, Cleveland, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. B. Hutchison, 1809 Capitol Ave., Omaha, Neb. Next meeting May 11-14, 1926, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York. Next meeting May 25-28, 1926, Hotel Statler, Buffalo, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in month, except June, July, August and September. Copley-Plaza Hotel, Boston, Mass. Next meeting April 13. A paper on designing locomotives to reduce rail stresses will be presented by H. H. Lanning, mechanical engineer, Atchison, Topeka & Santa Fe.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meeting third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York. Next meeting April 16. Paper on Gas electric drive for motor buses will be presented by H. L. Andrews of the General Electric Company.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CLUB OF GREENVILLE.—F. D. Castor, clerk, maintenance of way department, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHEASTERN CARMEN'S INTERCHANGE ASSOCIATION.—J. E. Rubley, Southern Railway shops, Atlanta, Ga.

TEXAS CAR FOREMEN'S ASSOCIATION.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings, first Tuesday in each month Terminal Hotel Bldg., Fort Worth, Texas. Next meeting April 6. Program in charge of Texas & Pacific Railway.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety eighth St., Cleveland, Ohio. Annual meeting September 14-17, Hotel Sherman, Chicago.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 226 W. Jackson Blvd., Chicago. Regular meetings, third Monday in each month, except June, July and August.

# Supply Trade Notes

The general offices of the Commonwealth Steel Company are now in the new office building at its plant in Granite City, Ill.

The Morton Manufacturing Company, Chicago, will construct a two-story factory 85 ft. by 220 ft., to cost approximately $95,000.

The Central Steel Company, Massillon, Ohio, has opened a district sales office at 404 West First street, Tulsa, Okla., in charge of L. S. Allen.

C. S. Carter has been appointed sales representative of the Locomotive Firebox Company, Chicago, with headquarters at Minneapolis, Minn.

H. J. Tierney, F-19 Railway Exchange, St. Louis, Mo., has been appointed St. Louis representative of the Davis Brake Beam Company, Johnstown, Pa.

A. S. Anderson, formerly secretary of the Terre Haute Malleable Manufacturing Company, Terre Haute, Ind., has been elected president of the Standard Malleable Castings Company to succeed Emil J. Fischer, resigned.

E. M. Ivens, formerly representative of the Ingersoll-Rand Company, with headquarters at New Orleans, La., has been appointed special agent of the Chicago Pneumatic Tool Company, with headquarters at Chicago.

James C. Dannaher will in future look after the Pacific coast railway business of the Murphy Varnish Company, Newark, N. J. Mr. Dannaher will have his headquarters at the company's San Francisco, Cal., branch, 555 Mission street.

H. B. Pflasterer, formerly sales representative of the Hazard Manufacturing Company, with headquarters in Chicago, has been appointed railroad sales engineer of S. F. Bowser & Co., Inc., Ft. Wayne, Ind., with headquarters in Chicago.

The Harnischfeger Corporation, Milwaukee, Wis., has appointed the William H. Hale Company, Minneapolis, Minn., its agent in Minnesota. The Clark-Wilcox Company, New Haven, Conn., also has been appointed agent to succeed the K. B. Noble Company.

The Boye & Emmes Company, Cincinnati, Ohio, has placed a contract with the Austin Company for an entire new plant to replace its old one-story and basement structure which was recently destroyed by fire. The new plant will be 90 ft. by 340 ft., of monitor type construction.

The Foster Bolt & Nut Manufacturing Company, Cleveland, Ohio, will construct an addition to its plant at Cleveland, following the completion of the addition which it is now constructing. This company is also erecting a plant at Chicago, which will be placed in operation by May 1.

C. E. Graham, formerly senior vice-president of the Chesapeake & Ohio, has now severed his last connection with the property by resigning as vice-president of the Hocking Valley. Mr. Graham has entered the general railway supply business in New York City, with office at 51 East Forty-second street.

A. H. Purdom, formerly connected with the railroad department of Johns-Manville, Incorporated, Chicago, Ill., has resigned to take a position in the railway department of the Wood Conversion Company, 310 South Michigan avenue, Chicago, manufacturers of refrigerator and passenger car insulations.

Ausborn F. Old, eastern sales manager, at New York, of the Hale-Kilburn Company, Philadelphia, Pa., died after a brief illness of pneumonia at the Fifth Avenue hospital in New York City, on March 16, at the age of 80. Mr. Old had been with this company for the past 35 years serving in its sales organization.

The Cutler-Hammer Manufacturing Co., Milwaukee, Wis., has opened a new sales office in the Healey building, Atlanta, Ga. A. C. Gibson, formerly of the Philadelphia office, is in charge of this office. The General Machinery Co., Birmingham, Ala., will continue to serve its trade in the northern half of Alabama.

R. J. Sharpe, district representative at Tulsa, Okla., of the General American Tank Car Corporation, Chicago, has been appointed general sales manager, with headquarters at the general offices in Chicago. J. V. O'Neil has been appointed district representative at Tulsa, succeeding Mr. Sharpe.

The Twentieth Century Gravity Lubricator Company has been incorporated, with headquarters at 21 Kolb avenue (Belmar), Baltimore, Md. W. E. Crist is president and treasurer; C. W. MacQueston, vice-president, and S. S. Crist, vice-president and secretary. The company was organized to manufacture oil cup lubricators for journal boxes.

The DeVilbiss Manufacturing Company, Toledo, Ohio, will spend more than $1,000,000 this year on the enlargement of its plant and the beautification of its grounds. The principal new buildings will be an office building, 180 ft. by 80 ft., and a factory building, 582 ft. by 80 ft., both of which will be connected by bridges and covered passageways.

T. W. Bennett, service engineer for the Locomotive Stoker Company, Pittsburgh, Pa., is now in Australia to supervise the initial operation of Duplex stokers on ten new Mountain type locomotives built according to American practice, by the Sir W. G. Armstrong Whitworth Company in England, which will soon go into service in South Australia.

The Interstate Car & Foundry Company, Indianapolis, Ind., formerly the Interstate Car Company, has been organized by G. J. Diver, manager of the Interstate Car Company, who will be president, and L. R. Meyer, also connected with the Interstate Car Company, who will be vice-president and secretary. The new company will manufacture grey iron and semi-steel castings.

Following the death of R. E. Bebb, chairman of the board, which was noted in the March *Railway Mechanical Engineer*, various officers of the Central Steel Company, Massilon, Ohio, were promoted as follows: F. J. Griffiths, chairman of the board; C. E. Stuart, president and treasurer; B. F. Fairless, vice-president and general manager; J. M. Schlendorf, vice-president in charge of sales, and Charles C. Chase, Jr., secretary. George H. Freeborn, who has been auditor of the company for a number of years, was elected a member of the board and assistant treasurer.

The Standard Forging Corporation, of Delaware, has elected the following directors and general officers: G. E. Van Hagen, president and general manager; C. R. Lewis, vice-president and general manager of sales; L. C. Ryan, vice-president and treasurer and A. C. Stockton, vice-president and secretary. The recently acquired Pollak Steel Company plant at South Chicago, Ill., will be operated under the name of Standard Forgings Company, South Chicago plant. The plant at Indiana Harbor, Ind., will continue under the name of Standard Forgings Company and the plant at East St. Louis, Ill., will continue under the name of St. Louis Forgings Company.

Lee & Clark has recently been incorporated to take over the business conducted as a partnership under the name of the James T. Lee Company. James T. Lee is president and John O. Clark is vice-president, with offices at 549 W. Washington Boulevard, Chicago. The company specializes in hydraulic equipment, plate working tools, metal working machinery, pumps, car wheel borers, pipe benders, flexible steam joints, etc. Mr. Lee was formerly vice-president of the Hanna Engineering Works, Chicago, and for the past five years was western manager of the Southwark Foundry & Machine Company. Mr. Clark, for a number of years, was sales manager of the Hanna Engineering Works, Chicago.

The Peerless Malleable Castings Company, Toledo, Ohio, has been incorporated as the successor to the United States Malleable Iron Company, the latter company having been sold in the federal court. Officers of the new company are Elmer H. Gerson, president; Ira L. Houghton, vice-president and general manager; and J. M. Weil, secretary and treasurer. Mr. Houghton entered the employ of the National Malleable Castings Company in 1891 as a core room clerk and since that time has been associated with the plants of the Michigan Malleable Iron Company, the Grand Rapids Malleable Works and the United States Malleable Iron Company. In 1916 he resigned from the latter company to organize and operate the Maumee Malleable Castings Company, Toledo, Ohio. In 1919 he sold his interest in that concern and in October, 1922, entered the employ of the United States Malleable Iron Company as vice-president and general manager, which position he has held until his recent appointment.

### A correction

In the item regarding the change in name of the Chicago Steel Car Company, Harvey, Ill., to the Gibson Car & Manufacturing Company, it was stated that there had been a change in the personnel of the company. This was incorrect as no change whatever was made in the official roster of the Chicago Steel Car Company when its name was changed, and no one in any other corporation has any interest in the Gibson Car & Manufacturing Company.

### Mr. Woodin optimistic

William H. Woodin, president of the American Car & Foundry Company and the American Locomotive Company has sailed recently on a business trip abroad. Before leaving he was quoted as saying that both of the companies of which he is the head are now operating in excess of 50 per cent of capacity. Continuing he added:

"The acquisition of the Hall-Scott, Fageol, and J. G. Brill Company by the American Car & Foundry Securities Corporation should add materially to the earnings of American Car & Foundry Company. Hall-Scott makes one of the best motors on the market and if the need arises, American Car & Foundry has four large car-building plants which may be turned over to bus-body making on short notice.

"I also want to deny the rumor that American Car & Foundry is thinking of acquiring the Pullman Car & Manufacturing Company if it is ever segregated from the Pullman Company proper, because the Federal Trade Commission would not allow such a merger, as it would be in restraint of trade. You will notice that all the mergers which we have participated in have been for the benefit rather than the restraint of trade; they have not been with competing companies."

### American Locomotive Company to acquire Railway Steel Spring Company

One of the most important developments in the railway supply field in a long period of years is contained in the recent announcement that the American Locomotive Company will take over the Railway Steel Spring Company. Stock of the locomotive company will be issued in exchange for stock of the spring company. Frederick P. Fitzpatrick, president of the Railway Steel Spring Company, is to become president of the locomotive company, and William H. Woodin, president of the American Car & Foundry Company and of the locomotive company, is to become chairman of the board of the enlarged locomotive company.

The official announcement gave details as follows:

"The boards of directors of the American Locomotive Company and the Railway Steel Spring Company, realizing that there are substantial economic advantages to be gained by a merger of the two companies, after a careful analysis of the two properties, have agreed upon what they believe to be the proper ratio of exchange, and are calling stockholders' meetings of their respective companies, recommending their approval of the merger.

"The Locomotive stockholders will be asked to increase both the preferred and common capital of their company so that they may, if the Railway Steel Spring shareholders accept the recommendation of their board, acquire the assets of the Railway Steel Spring Company by the delivery of securities that will permit each preferred stockholder of the Railway Steel Spring to receive one share of American Locomotive preferred for a share of Railway Steel Spring preferred, and each holder of a share of Railway Steel Spring common to receive two-thirds of a share of Locomotive common.

This merger and the basis agreed upon is approved by the largest shareholders of both companies.

### Obituary

Robert Hobson, chairman of the board of the Canadian Locomotive Company, Ltd., Hamilton, Ontario, and president of the Steel Company of Canada, Ltd., died on February 25 at his home in Hamilton, at the age of 65. He first began work on the railroads but later became secretary-treasurer of the Hamilton Blast Furnace Company. In 1899 he went to the Hamilton Iron & Steel Company as general manager, and in 1910 was appointed general manager of the Steel Company of Canada, Ltd., becoming president of that company in 1916. He had served also as an officer or a director of a number of financial and industrial organizations.

# Trade Publications

WRENCHES.—A miniature 56-page, illustrated catalogue of Williams Superior drop-forged wrenches is being issued by the J. H. Williams & Co., Buffalo, N. Y.

POWER DRIVE.—A four-page folder descriptive of the No. 44 Beaver power drive for cutting, reaming and threading pipe has been issued by the Borden Company, Warren, Ohio.

SEPARATOR MAGNETS.—The construction details and operating characteristics of E. C. & M. separator magnets are given in a four-page illustrated folder issued by the Electric Controller & Manufacturing Company, Cleveland, Ohio.

GASKETS.—Catalogue 26, descriptive of a complete line of gaskets for air compressors, boilers, drums, joints, etc., has been issued by the Metallo Gasket Company, 12 Bethany street, New Brunswick, N. J. Price lists also are included in this catalogue.

LOCOMOTIVE FORCE FEED OILER.—A thermostatically controlled heater is embodied in the new Model A locomotive force feed oiler which is described in Bulletin No. 18 issued by the Detroit Lubricator Company, Detroit, Mich. The details of construction of this lubricator are shown in various cross-sectional drawings.

BONNEY WRENCHES.—Catalogue No. 26 issued by the Bonney Forge & Tool Works, 405 Stephen Girard building, Allentown, Pa., has been reproduced in miniature in order to provide a handy reference for the mechanic. The three types of "CV" chrome vanadium socket wrenches; namely, the offset, "T" handle and the speed type, are shown in this catalogue.

SMALL TOOLS.—A new edition of a small tool catalogue, to which has been added for the first time pages descriptive of special work, special gages, the correct use of tools under actual shop conditions and new tables, has been issued by the Brown & Sharpe Manufacturing Company, Providence, R. I. Among the tools listed in this catalogue, No. 30, are micrometers, rules, gages, punches, scribers, screw machine tools, cutters, etc.

NICKEL STEEL DATA AND APPLICATIONS.—The International Nickel Company, New York, is issuing a series of twelve technical bulletins on nickel steel. Bulletin No. 1 describes the Society of Automotive Engineers standard specifications for steel and Bulletin No. 2, the physical and mechanical properties of nickel steels. Subsequent bulletins will be issued at bi-monthly intervals. Binders for these loose leaf bulletins will be furnished on request.

THREAD STANDARDIZATION.—In accordance with the recommendations adopted by the die head and chaser industry in collaboration with the Department of Commerce, Division of Simplified Practice, the Geometric Tool Company, New Haven, Conn., is issuing in folder form tabulations of those sizes of chasers which it considers stockable and which will be furnished without extra charge. All other chasers not listed in these tables will be regarded as non-stockable.

LEATHER BELTING.—A report of experiments conducted by R. F. Jones, research engineer, at Cornell University, to determine the relative power transmitting capacity of belts on vertical, angular and horizontal drives has been issued by the Leather Belting Exchange, 119 South Fourth street, Philadelphia, Pa. In this report the author also has correlated the results with the method of belt design published in pamphlet R-13, so that this same system with modifications can now be used for vertical and angular drives.

BAR WORK.—Book 1 of a series on modern tooling methods giving practical information and suggestions for the correct handling of turret lathe tool equipment for both large and small lot production, has been issued by The Warner & Swasey Company, Cleveland, Ohio. The problems of bar work are discussed in this book; a number of typical bar tool layouts given; the design of individual tools treated, and the possibilities of developing a Universal tooling equipment shown. The next two books of the series will deal with chuck work and will discuss the principles of increasing production, giving particular attention to holding devices.

# Personal Mention

## General

B. L. Butler has been appointed water service and fuel supervisor of the Southern Pacific, with headquarters at Dunsmuir, Cal., to succeed J. B. Duncan, Jr., resigned.

J. H. Reisse, mechanical inspector of the Chicago, Burlington & Quincy, at Chicago, has been appointed mechanical assistant to the vice-president, with the same headquarters.

D. R. MacBain has been promoted to general manager of the New York Central, lines west of Buffalo, with headquarters at Cleveland, Ohio. Mr. MacBain was born on October 23, 1861, at Queenston Heights, Ont., and entered railway service in October, 1876, as a machinist apprentice on the Canadian Southern, now a part of the Canadian National. He was promoted to locomotive fireman in May, 1878, and in 1882 was promoted to locomotive engineer. Mr. MacBain was appointed traveling engineer on the Canada division of the Michigan Central in 1890, and three years later was transferred to the district west of the Detroit river. He was promoted to master mechanic of the Western division in July, 1900, and in April of the following year was transferred to St. Thomas, Ont. He was transferred to Jackson, Mich., in January, 1902, and remained there until July, 1906, when he was promoted to assistant superintendent of motive power, with headquarters at Detroit. Mr. MacBain was transferred to the New York Central, with headquarters at Albany, N. Y., in April, 1908, and in May, 1910, was promoted to superintendent of motive power of the Lake Shore & Michigan Southern, the Lake Erie & Western, the Lake Erie, Alliance & Wheeling, the Dunkirk, Allegheny Valley & Pittsburgh, the Cleveland Short Line, the Chicago, Indiana & Southern and the Indiana Harbor Belt. He was promoted to assistant general manager of the lines west of Buffalo, with headquarters at Cleveland, in June, 1919, and held that position until his recent promotion to general manager.


D. R. MacBain

## Master Mechanics and Road Foremen

F. E. Sellman has been appointed assistant master mechanic of the Pennsylvania with headquarters at Akron, Ohio.

E. J. Cyr has been appointed assistant master mechanic of the Galesburg division of the Chicago, Burlington & Quincy, succeeding J. S. Ford.

H. C. Turner has been appointed assistant master mechanic of the Ottumwa division of the Chicago, Burlington & Quincy, with headquarters at Burlington, Ia.

J. T. Leach, master mechanic of the Pennsylvania, with headquarters at Mahoningtown, Pa., has been transferred to Wellsville, Ohio, succeeding F. E. Sellman.

J. S. Ford, assistant master mechanic of the Galesburg division of the Chicago, Burlington & Quincy, at Galesburg, Ill., has been promoted to master mechanic of the Galesburg division in place of W. A. Kelly.

W. A. Kelly, master mechanic of the Galesburg division of the Chicago, Burlington & Quincy, at Galesburg, Ill., has been transferred to the Ottumwa division, with headquarters at Ottumwa, Ia., succeeding H. C. Turner.

## Shop and Enginehouse

H. L. Shaw has been appointed erecting shop foreman of the Chicago & Alton, with headquarters at Slater, Mo., succeeding W. H. Dillon, resigned.

W. B. Murney, traveling locomotive inspector of the St. Louis-San Francisco, has been appointed general enginehouse foreman, South Enginehouse, with headquarters at Springfield, Mo., succeeding F. W. Lampton, resigned.

## Car Department

L. R. Christy, general car inspector of the Missouri Pacific, with headquarters at St. Louis, Mo., has been promoted to master car builder of the Gulf Coast Lines and the International Great Northern, with headquarters at Houston, Tex., a newly created position.

## Obituary

John T. Ewing, engineer of tests of the Chesapeake & Ohio, died on March 4, of heart disease in the Stuart Circle Hospital, Richmond, Va.

Benoit Briard, purchasing agent of the Chicago Great Western, with headquarters at Chicago, died in that city on February 11 after an operation for appendicitis. Mr. Briard was born on February 9, 1865, in St. Louis, Mo., and entered railway service in June, 1879, as a messenger in the office of the local freight agent of the Chicago & Alton at Chicago. In December, 1879, he took up the study of telegraphy, returning later to the Chicago & Alton as telegraph operator and clerk in the local freight office at Chicago. He was transferred to the general freight department in 1880 and in April, 1882, was transferred to the purchasing department. Mr. Briard was promoted to stationer in January, 1894, later being promoted to chief clerk and assistant to the purchasing agent. He was later promoted to chief stationer of the Alton, the Toledo, St. Louis & Western, the Minneapolis & St. Louis and the Iowa Central. In November, 1909, Mr. Briard was appointed purchasing agent of the Chicago Great Western and he held that position until his death.

W. J. Tollerton, general superintendent of motive power of the Chicago, Rock Island & Pacific, with headquarters at Chicago, died in that city on March 3, of intestinal influenza. Mr. Tollerton was born in 1870 at St. Paul, Minn., and was educated in the public and high schools. He entered railway service as a machinist apprentice on the St. Paul & Duluth, now a part of the Northern Pacific, and subsequently became a fireman on the Chicago, St. Paul, Minneapolis & Omaha. From 1890 to 1896 he was a foreman and afterwards general foreman of the Union Pacific, and from the latter date until 1903 was master mechanic of the Utah division of the Oregon Short Line. From 1903 to July, 1906, he was master mechanic of the Idaho, Utah and Montana divisions of the same road at Pocatello, Idaho. He then became superintendent of motive power of the Chicago, Rock Island & Pacific, in charge of the lines west of the Mississippi river, with headquarters at Topeka, Kans., where he remained until April, 1907, at which time he became assistant general superintendent of motive power of the Rock Island Lines, with headquarters at Chicago, Ill. He became mechanical superintendent in May, 1912, and general mechanical superintendent on January 1, 1913. In May, 1923, Mr. Tollerton's title was changed from general mechanical superintendent to general superintendent of motive power.


W. J. Tollerton